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STUDII ŞI COMUNICĂRI 2006	Vol. 21: 13 – 19

PART I - VEGETAL BIOLOGY

DE LA DESCOPERIREA CELULEI (1665, 1667) LA TEORIA CELULARĂ (1838, 1839)

Referat

CONSTANTIN TOMA*
LĂCRĂMIOARA IVĂNESCU

ABSTRACT

TOMA C., IVĂNESCU L., 2006 - From cell discovery (1665 ,1667) to cellular theory (1838, 1839). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol.21: 13-19.

The study presents chronologically the authors and the events succeeded in 173 years (1665-1839) from the cell discovery until the elaboration of the cellular theory. This brief presentation regarding to the difficulties of entering in the small universe of the living world can serve as a model of persistence for the since men engaged in unravel the nature secrets.

Key words: microscope, cell, cellular theory.

Primele microscoape şi descoperirea celulei

Istoria celulei nu datează decât de la inventarea microscopului, iar progresele citologiei sunt strâns legate de perfecţionările acestui admirabil instrument.

În 1590**, fraţii **Hans** şi, mai cu seamă, **Zacharias Jansen** (olandezi) descoperă principiul microscopului compus, construind aparate alcătuite ca şi cele actuale, adică având condensator, obiectiv şi ocular. Numai că imaginile erau foarte deformate, puterea de mărire nu depăşea câteva zeci de ori. Au urmat alte eforturi, „amatori” de a construi microscoape cu o putere de rezoluţie mai mare. Cel mai celebru dintre aceşti „amatori” a fost **Antony van Leewenhoek** (postăvar olandez şi persoană de vază în oraşul Delft), în 1683 el montează lentile simple pe suporturi foarte atent lucrate, prevăzute cu un port-obiect în formă de ac de împletit, care-i permitea să atingă o putere de mărire de 200-275 ori. Cu acest microscop, construi de el, observă-pentru prima dată-celule vii: infuzori, bacterii, protozoare, spermatozoizi, globule roşii, toate sub termenul de „animalicule”†. În 1667, italianul **Bonnani** realizase deja primul sistem de iluminare prin transparenţă.

Câţiva ani mai devereme (1665), un fizician englez, **Robert Hooke**, care adusese importante perfecţionări microscopului construit de fraţii **Jansen**, examinând o secţiune transversală printr-un dop de plută (suber), observă cavităţi pe care le numeşte ***celule***; el compară secţiunea prin dopul de plută cu un fagure de albine. În „*Micrographia*” sa (*Micrographia or some physiological descriptions of minute bodies made by magnifying glasses with observations and inquieries thereupon*), apărută la Londra în 1667, el dă descrierea şi desenul texturii suberului, reprezintă multe alte obiecte văzute la microscop.

Hooke era fizician, matematician, arhitect; observaţiile sale nu aveau alt scop decât să dovedească unitatea microscopului său. El nu se îndoia de importanţa descoperirii făcute, dar nici nu bănuia ce profit va trage anatomia vegetală din descoperirea sa.

În cartea la care ne-am referit mai sus (*Micrographia*), **Hooke** foloseşte pentru prima oară termenul de ***celulă*** (cell) şi de ***perete*** (wall). Pentru el, ţesutul în discuţie era constituit din cavităţi lipsite complet de conţinut‡, din celule în sensul elementar şi banal al termenului.

Câţiva ani mai târziu, englezului **Nehemia Grew** şi italianului **Marcelo Malpighi** le revine onoarea de a fi sesizat marea importanţă a

* “Al.I.Cuza” University of Iasi, Faculty of Biology

După **Pilet, anul descoperirii microscopului ar fi 1580, iar descoperitorul ar fi doar **Zacharias Jansen**.

† În perioada 1715 – 1719 publică lucrarea intitulată „*Opera omnia*”.

‡ Ştiut fiind că pluta (suberul) este un ţesut mort.

descoperirii lui **Hooke**. Ei comunică rezultatul cercetărilor lor la Societatea regală de la Londra într-o notă preliminară:primul la 11 mai 1671, al doilea la 7 decembrie a aceluiaşi an.

Lucrarea lui **Grew** (*Anatome plantarum*) apare în 1672, iar cea a lui **Malpighi** (*Opera omnia*), în 1675 şi 1679. Aceşti autori, fondatorii ***anatomiei plantelor*** ca ştiinţă, recunosc faptul că diversele organe ale plantelor sunt compuse din părţi elementare, din care unele au formă de saci prevăzuţi cu un perete rigid şi umplute cu un lichid, ***utricule*** şi ***vezicule***, altele au formă de tuburi ce parcurg ţesutul fundamental, tuburi desemnate mai târziu prin termenul de ***vase***. Aceşti termeni, mai ales cei de vezicule şi utricule, au fost folosiţi tot secolul XVIII pentru a desemna celulele observate şi denumite de **Hooke**. Abia la 1800. **Brisseau-Mirbel** reia în lucrările sale denumirea de ***celulă***, care sfârşeşte până a prevala.

Lucrarea „*Opera omnia*" a lui **Malpighi** constituie, fără îndoială, prima operă de ***anatomie generală***, animală şi vegetală. Autorul descrie mai ales celulele, sub termenul de „sacule" şi de vase, pe care le numeşte cu termenul de „tuburi".

Lucrarea „*Plant anatomy*" a lui **Grew** este de o factură aproape modernă; ea are 83 de planşe (printre primele gravate pe cupru) ce arată un număr mare de organe şi de ţesuturi vegetale, în care sunt reprezentate numeroase celule. Ţesuturile parenchimatice sunt descrise ca fiind formate din „celule" sau din „vezicule" (bladders) transparente, şi termenul de „vase" (vessels) este folosit pentru a descrie nu numai elementele conducătoare, dar şi structuri precum laticiferele.

Dar, ca şi în descrierea suberului, de către **Hooke**, peretele este considerat de cei doi anatomişti ca materie vegetală şi nu conţinutul celulei. Iată cum se exprimă **Grew** în 1671 pentru a evoca geneza unui parenchim plecând de la o licoare fluidă în timpul dezvoltării seminţelor: „În cursul coagulării, are loc şi o uşoară fermentaţie, se constituie parenchimul, nu de la o textură oarecare, ci este edificat într-o masă de vezicule, cum vedem pâinea în brutărie: căci la fel este parenchimul întregii seminţe". Vom regăsi această concepţie a genezei de celule prin solidificarea veziculelor născute într-un lichid primordial, timp de aproape două secole mai târziu, în operele fondatorilor teoriei celulare (**Schleiden**, 1838; **Schwann**, 1839). Concepţiile lui **Malpighi** şi **Grew** se regăsesc şi în *Theoria generationis* a lui **Wolff***[§] (1759). Însuşi termenul de „celulă" eate uitat.

Teoria tisulară. În operele lui **Malpighi** şi **Grew**, care au fondat anatomia microscopică, celula însăşi nu reţine atenţia tot atât cât diversele ţesuturi din care sunt constituite organele, deoarece conţinutul celular rămâne ignorat. Această „concepţie tisulară" nu va fi pe deplin dezvoltată decât aproape după un secol de la publicarea lucrărilor lui **Malpighi** şi **Grew**, de către **Brisseau-Mirbel**, în al său „*Traité d`Anatomie et de Physiologie végétales*" (1801), şi de către **Sprengel**, într-un „*Traité de Botanique*", apărut în 1802.

Cei doi autori sunt, de altfel în dezacord şi polemizează asupra ideilor astăzi complet perimate. Dar, pentru amândoi, ţesutul celular se constituie în sânul unui lichid primordial.

„Vegetalele, scrie **Mirbel**, sunt formate dintr-un „ţesut membranos" care, deşi continuu în toate părţile sale, formează două feluri de organe diferite: „ţesutul celular" şi „ţesutul tubular".

Pentru el, substanţa fundamentală este membranoasă şi omogenă şi celulele nu sunt decât cavităţi amestecate (aflate) în această substanţă.

Pentru a explica geneza ţesutului membranos, **Mirbel** reia ideea lui **Grew** privind un lichid în fermentaţie, ale cărui bule se coagulează în membrane. Această concepţie implica faptul că fiecare membrană ar fi comună a două celule adiacente. Această consecinţă fu urgent infirmată şi ruină curând teoria tisulară.

Începând din 1812, mai mulţi autori vor arăta că se pot izola celule vegetale, plecând de la ţesuturi, prin maceraţie în apă (**Moldenhawer**, 1912), prin fierbere (**Link**), pe păstăi de fasole, sau prin acid nitric (**Dutrochet**, 1824). Au urmat discuţii care opun pe **Dutrochet** lui **Mirbel** şi incită la lucrări fructuoase. La sfârşitul carierei sale **Mirbel** (într-un foarte frumos articol asupra hepaticei Marchantia polymorpha, publicat în 1835) se raliază ideilor lui **Dutrochet** care fondează în mod real teoria celulară.

Astfel, în 1824, **Dutrochet** se exprimă în aceşti termeni: „Aici, eu trebuie să reamintesc ceea ce am expus mai sus privind textura (ţesătura) organică a vegetalelor: am văzut că aceste fiinţe erau compuse în întregime sau din celule, sau din organe care derivă în mod evident din celulă; am văzut că aceste organe cu cavităţi erau pur şi simplu contigue şi aderente unele cu altele printr-o forţă de coeziune, dar că ele nu formau deloc, prin asamblarea lor, un ţesut realmente continuu; astfel că, de atunci, fiinţa organică ni s-a părut formată dintr-un număr infinit de piese microscopice care nu au între ele decât raporturi de vecinătate".

Aşadar, **Moldenhawer**, în 1812, separă prin maceraţie celulele vegetale unele de altele. El demonstrează astfel că fiecare celulă are un perete Primul care observă insulele sanguine în aria vasculară a embrionului de pui.propriu şi, deci, nu este o simplă cavitate scobită într-o masă fundamentală lichidă, cum crezuse **Brisseau-Mirbel**.

După 1830 încep să fie descoperite, rând pe rând, diferitele organite celulare. În 1828, **Meyer** evidenţiază granulele de clorofilă şi de amidon, precum şi cristalele de săruri organice şi minerale.

§ Primul care observă insulele sanguine în aria vasculară a embrionului de pui.

Până la formularea „oficială” a teoriei celulare, în 1831 **Robert Brown** descoperă şi denumeşte nucleul în celulele epidermice de la orhidee, organit ce fusese sporadic observat şi de **Fontana** în 1781; după cercetările sistematice întreprinse de **Brown**, nucleul este interpretat ca o structură celulară constantă şi fundamentală, organit normal al celulei. În 1836, **Valentin** evidenţiază şi nucleolul, ca structură constantă în fiecare nucleu.

Cât despre citoplasmă, subliniem faptul că în 1838 **Schleiden** descria o „substanţă nutritivă” având aspectul unei gume, pe care el o numea „citoblastem” şi care se aduna în jurul nucleului la celulele presupuse „în formare”. Cu trei ani înainte (1835), **Dujardin** denumea materia vie din celulă cu termenul de „sarcodă”; acelaşi autor, în acelaşi an, evidenţiază vacuolele la protiste, formaţiuni ce vor fi descrise ulterior, în celulele vegetale, de către **Naegeli**. În 1837, **Mohl** şi **Michler** au recunoscut localizarea pigmenţilor fotosintetizanţi sub formă de granule de clorofilă, pe care ei le credeau elaborate de citoplasmă. Adevărata descoperire a plastidelor va avea loc mult mai târziu, de către **Schimper** şi **Meyer**.

Aşadar, până la această vreme se considera celula ca o veziculă închisă de un perete solid, conţinând un lichid u nucleu şi nucleol, uneori alături de cristale, granule de amidon, granule de clorofilă, etc. Dar, mai toate observaţiile se făceau la microscoape simple, adică lupe cu lentile având o foarte mică distanţă focală şi un câmp foarte redus. Numai apoi s-au folosit microscoape cu ocular şi obiectiv, iar în 1798, fraţii **Jones** pun în vânzare primul microscop de concepţie modernă, cu port-obiect, oglindă, două oculare, tub glisant, platină, şuruburi macro-ţo micrometrice, condensator.

Urmează o perioadă de stagnare a cercetărilor în acest domeniu, înainte de o nouă explozie de descoperiri, înainte de formularea teoriei celulare.

Din cele prezentate până aici, se poate remarca faptul că descoperirea şi studiul iniţial al celulei rămâne strict opera botaniştilor. Observaţiile originale se referă îndeosebi la ţesuturile vegetale. Totuşi, **Wolff** publicase în 1774 un remarcabil tratat (*Theoria generationis*), în care se propunea o teorie veziculară a organelor vegetale şi animale, comparând globulele sanguine cu „saculele” din plantă.

Formularea teoriei celulare

În ştiinţele vieţii, alături de **toria darwiniană** a evoluţiei, şi **teoria celulară**, formulată de botanistul **Schleiden** (în 1838) şi zoologul **Schwann** (în 1839) merită titlul de „mare teorie”, „mare descoperire”, pentru a sublinia amploarea şi importanţa ei, caracterul sintetic şi fecunditatea ei.

Afirmând că celula este unitatea de bază a tuturor organismelor, cei doi naturalişti germani propuneau de fapt un program de cercetare de mare amploare. Deşi mai multe din tezele lor aveau să fie considerabil modoficate, cercetările lor de microscopie marchează o etapă extrem de importantă în istoria biologiei.

Aproape totdeauna, o teorie nouă este precedată de o muncă îndelungată de elaborare, de eforturi dispersate, de tentative fragmentare. Vine, în sfârşit, momentul când ideile s-au cristalizat, îşi găsesc expresia completă în gândirea unui om superior care survine la momentul favorabil.

o o o

În 1838, **M. Schleiden** publică lucrarea „*Beiträge zur Phytogenesis*”, în care-bazându-se pe rezultatele prdecesorilor săi, remarcând prezenţa constantă a nucleului în celulele tinere-caută să rezolve problema originii acestora. El atribuie nucleului o mare importanţă, considerându-l generatorul celulei şi, din acest motiv, îi dă numele de citoblast. După el, în substanţa fundamentală, numită citoblastem, apare mai întâi un nucleol, în jurul căruia se formează un citoblast, iar la suprafaţa acestuia se diferenţiază un perete (numit membrană la acea vreme), care creşte, se depărtează de nucleu (citoblast), lăsând un spaţiu în care pătrunde prin filtrare substanţa fundamentală.

În lucrarea menţionată **Schleiden** a enunţat cu precizie generalitatea structurii celulare a plantelor şi a căutat să dea o semnificaţie acestei organizări. El definea plantele ca „agregate” de fiinţe complet individualizate, independente şi distincte, care sunt celulele; fiecare din ele are o dublă existenţă: una proprie, care corespunde dezvoltării ei, alta ocazională, ca unitate a plantei.

Din păcate, el susţinea teza (falsă) a formării libere a celulelor plecând de la o matrice (substanţa) neorganizată (blastem), într-o vreme când observaţiile ce arătau că celulele ar proveni din celule preexistente devin din ce în ce mai numeroase în regnul vegetal.

Aşadar, spre sfârşitul deceniului 4 al secolului XIX, un anumit număr de progrese decisive aveau să fie realizate, progrese care fac posibilă enunţarea teoriei celulare:

- descoperirea organizării celulare a plantelor şi existenţa de celule în anumite ţesuturi animale,
- identificarea nucleului în celulele vegetale şi în unele celule animale,
- descoperirea în interiorul unor celule a materiei vii fundamentale, numită protoplasmă.

Zoologul **Th. Schwann**, teoretician recunoscut şi abil experimentator, îi datorează lui **Schleiden** impulsul dat pentru formularea teoriei sale, dar şi pentru acceptarea unor idei false privind originea celulelor. Cercetările lui **Schwann** s-au făcut în domeniile cele mai diferite, punctul lor de plecare fiind aproape întotdeauna o problemă de fiziologie.

În 1839, **Schwann** publică lucrarea „*Recherches microscopiques sur la conformité de* *structure et d'accroissement des animaux et des plantes*", care se bazează pe datele lui **Schleiden** şi pe observaţiile proprii. În această lucrare **Schwann** afirmă că celula este unitatea de bază a tuturor organismelor. Deşi mai multe din tezele lui, ca şi cele ale lui **Schleiden**, aveau să fie considerabil modificate, cercetările celor doi naturalişti, unul botanist, altul zoolog, marchează o etapă foarte importantă în istoria biologiei. În 1839 era prezentată, pentru prima dată, „***teoria celulară***" sub această desemnare explicită.

De acum înainte, celula nu mai este definită prin perete, ci prin conţinut, o masă citoplasmatică ce conţinea un nucleu. Aceste unităţi-celulele, sunt în acelaşi timp suportul activităţilor plastice şi al activităţilor metabolice ale fiinţelor vii. Dezvoltarea este consecinţa creşterii şi formării altor unităţi; celelalte funcţii, precum motricitatea, sunt legate de o diferenţirere a conţinutului. Activităţile metabolice nu se explică numai prin compoziţia materiei vii, ci şi prin organizarea sa. De exemplu, secreţiile nu rezultă dintr-o simplă exudare celulară (cum se afirma în mod curent la cea vreme), ci sunt produşi ai activităţii celulare. La animale, ele pot da naştere la substanţe interstiţiale solide (os, cartilagiu) sau lichide (limfă), însă acestea-o dată izolate- nu mai manifestă activităţi vitale.

Teoria celulară, elaborată de **Schleiden** şi **Schwann**, dar enunţată explicit de către acesta din urmă, se distinge-în acelaşi timp-prin numite construcţii spculative, care neglijează confruntarea sistematică cu experienţa, şi prin anumite tentative inductive, care se limitează la stabilirea faptelor generale plecând de la compararea datelor obţinute.

Teoria celulară prezintă cele două trăsături ale unei teorii ştiinţifice operaţionale.

- pe de o parte, ea a fost confirmată de confruntarea cu experienţa;

- pe de altă parte, ea a stimulat cercetarea biologică şi a favorizat o dezvoltare explozivă a biologiei generale în acelaşi timp prin ideile pe care le vehicula şi prin reînnoirea tehnicilor şi metodelor de cercetare pe care a pomovat-o.

La ce serveşte teoria celulară?

Ea identifică unitatea de bază a oricărui organism-celula.

Ea face posibil să se înţeleagă ceea ce este comun între organismele cele mai simple (unicelulare) şi orgnismele cele mai complexe (pluricelulare).

Continuând ideile lui **Schwann**, embriologul german **Oscar Hertwig** va rezuma astfel esenţialul acestei noi concepţii biologice: „ Animalele şi plantele, atât de diverse în aparenţa lor externă, se aseamănă între ele prin natura fundamentală a structurii lor anatomice, căci, atât unele cât şi altele sunt compuse din unităţi elementare similare, care sunt în general perceptibile cu ajutorul microscopului".

Desăvârşirea formulării teoriei celulare

Lucrările publicate de **Schleiden** şi **Schwann** au determinat o mişcare şi au dezvoltat o logică care au permis foarte repede să se rectifice anumite erori grave şi să se confirme unele afirmaţii care la prima vedere erau sau păreau hazardante. Inexactităţile referitoare la originea celulelor au fost disipate.

Polarizarea cercetărilor pe tema diviziunii celulare şi progresele microscopiei au permis să se multiplice observaţiile privind diviziunea celulelor vegetale (**Naegeli**, 1845; **Hofmeister**, 1849) şi a unor celule animale, mai cu seamă oul în segmentare (**Remak**, 1852).

Pe la mijlocul secolului al XIX-lea, fitofiziologul **Sachs** emite ***teoria organismală***, conform căreia planta formează celule, nu celulele formează planta. Organismul este o masă mai mult sau mai puţin continuă, de protoplasmă, în care celulele sunt unite prin plasmodesme, rezultând un simplast. După cum bine se înţelege, această teorie nu a găsit adepţi, cel puţin printre zoologi.

Virchow extinde observaţiile la celulele patologice şi formulează celebrul aforism „omnis cellula e cellula" (1855). Puţin după aceea, lucrările lui **Pasteur** dau o lovitură dură teoriilor generaţiei spontanee a microbilor. Apropierea celor două domenii face din autoreproducerea celulelor un caracter, o trăsătură esenţială a sistemelor vii. Tot acum este stabilită şi natura unicelulară a protozoarelor.

Cum a fost primită teoria celulară?

În Germania, exceptând unele medii medicale, această teorie a fost primită favorabil, adesea chiar cu entuziasm. Ea serveşte drept cadru conceptual pentru majoritatea tratatelor de histologie şi de anatomie comparată, care se multiplică în perioada 1840-1860; este locul aici să amintim că în 1859 apare renumita lucrare „*Patologie cellulaire*", elaborată de **Virchow**.

Timp de mai multe decenii, citologii au fost conduşi şi stimulaţi în a inventa tehnici şi a dsecoperi instrumente pentru a putea răspunde problemelor puse de teoria celulară. Cerectările lor au permis desăvârşirea formulării (teoriei celulare) şi au constituit punctul de plecare al celor mai multe descoperiri în biologia generală, care se vor multiplica sensibil în perioada 1860-1900.

În Anglia, teoria celulară întâmpină reticenţe considerabile în mediile medicale, deoarece utilizarea microscopului risca să bulverseze metodele de diagnostic.

În Franţa, teoria celulară a fost respinsă de către singurul profesor titular al unei catedre de Histologie (la Sorbona)-**Ch. Robin**. Teoria nu pătrunde în învățământul medical decât după crearea unei catedre de Histologie, concurentă, la Collège de France (1875) şi moartea lui **Ch. Robin** (în 1879). Dimpotrivă, Universitatea din Strasbourg a jucat un mare rol în răspândirea teoriei celulare datorită zoologului **Lereboullet** şi fiziologului **Kuss**, care traduc în 1842 lucrarea lui **Schwann**.

Ostilitatea față de teoria celulară se datoreşte la doi factori:

- pe de o parte, unii refuzau folosirea tehnicilor noi, care bulversează condițiile de acces la cunoaştere;
- pe de altă parte, alții reacționează în funcție de un „a priori" filosofic, empirist şi pozitivist.

Dar, posibilul devine necesar în perioada 1860-1900. În această perioadă, teoria celulară orientează două demersuri complementare:

- aprofundarea cunoştințelor asupra organizării şi dezvoltării celulei;
- explicarea funcțiilor generale ale ființelor vii în termenii biologiei celulare.

Au loc perfecționări ale microscopului fotonic, prin faptul că se inventează: obiectivele apocromatice; obiectivul cu imersie; diafragma; condensatorul.

În mod deosebit se remarcă întreprinderea industrială Zeiss (1881) de către fizicianul **Abbé** (care studiază formarea prin difracție a imaginii), chimistul **Schott** şi industriaşul **C. Zeiss**. Primii care utilizează microscopul Zeiss sunt marii citologi germani **Hertwig** şi **Flemming**.

Tot în această perioadă se perfecționează tehnicile de fixare şi de confecționare a preparatelor: includere în parafină, secționare la microtom, colorare (1880).

Evoluția conceptelor relative la celulă,
după statuarea teoriei celulare

O dată cu **Schwann**, nucleul devine reperul principal al existenței celulei, dar tehnicile din vremea sa nu permiteau a urmări permanența sa în numeroase cazuri.

- Între 1870 şi 1880 au fost descrise figuri ale mitozei: **Strasburger** (1875) la plante şi **Remak** (1880) la animale; ei stabilesc că mitoza este forma generală de diviziune celulară.
- În 1885, **Rahl** subliniază permanența cromosomilor în interfază, numele de cromosomi fiind dat mai târziu (1888) de **Waldeyer**.
- Din 1880, interesul cercetătorilor se îndreaptă tot mai mult asupra citoplasmei, după ce în 1879 **Strasburger** elborează aforismul „omnis nucleus e nucleo"; el este cel care în 1876 descrisese fazele diviziunii celulare, după care **Schleicher** (1878) dă numele de cariocineză. Curând, **Hertwig** (1879, 1880) descoperă fecundația, descriind cariogamia şi plasmogamia.

Este, aşadar, perioada descoperirii marii majorități a organitelor celulare: **Sachs** caracterizează detaliat vacuolele, **Flemming** descoperă centrosomul, **Schimper** denumeşte plastidele, **Flemming** şi **Guignard** arată că în cursul mitozei cromosomii se dedublează, **Altman** descoperă mitocondriile în celula animală, iar **Benda** confirmă prezența acestora la mai multe animale, **Guilliermond** descoperă condriosomii la plante şi tot el (după 1900) se va ocupa pe larg de vacuole, plastide şi condriosomi. Tot spre sfârşitul secolului al XIX-lea este descrisă meioza, iar **Navaşin** (1898) şi **Guignard** (1899) descoperă dubla fecundație la angiosperme.

Continuă intens cercetarea procesului de fecundație şi dezvoltarea organismului, ereditatea, fiziologia generală. În lucrările lui **Mendel** (1865) este utilizat termenul de celulă pentru a desemna gameții.

Începând din 1880, problema eredității devine o preocupare majoră a citologilor; ei cautăîn organizarea celulară suportul care permite a explica transmiterea caracterelor ereditare.

Imediat după 1900 se stabileşte existența heterocromosomilor caracteristici sexului şi se face determinarea cromosomică a sexului. Din 1930 se disting, in situ, cele două tipuri de acizi nucleici, prin metoda **Feulgen**. Se descoperă şi analizează hialoplasma cu incluziunile din ea: unele inerte (vacuole, granule de amidon şi de aleuronă), altele vii, cu o activitate metabolică precisă.

Disctiçția între un perete scheletic propriu celulei vegetale şi plasmalema comună celulelor din ambele regnuri a fost recunoscută chiar din 1900.

În perioada 1910-1930 se dezvoltă ***teoria cromosomică*** a eredității de către **Morgan** şi **Painter**. Datorită citologiei se redescoperă, spre 1900, legile lui **Mendel** şi se reiau studiul experimental al eredității prin hibridare, paralel cu cercetarea intensă a celulei procariote.

La sfârşitul acestei perioade (1940) se poate constata următorul paradox:

- pe de o parte teoria celulară a primit o consacrare oficială (imediat după 1900), prin introducerea ei în învățământul superior şi cel liceal;
- pe de altă parte, un anumit număr de cercetători sau istorici ai ştiinței o pun din nou în discuție.

În 1911, chiar, **Dabel** neagă faptul că protozoarele şi oul fecundat pot fi asimilate cu celulele; el refuză să le atribuie calificativul de ființe vii primitive şi le asimilează cu simple „materiale" ale organismelor pluricelulare.

Tema formării libere a celulelor (combătută cu fermitate şi argumente de **Pasteur**), plecând de la o substanță fundamentală, a fost reluată de mai multe ori, în special de **Nageotte** şi **Lepeşinskaia** (1945), dar observațiile lor nu au fost confirmate. În sfârşit, foarte pe scurt despre **Reînnoirea teoriei celulare începând din 1945**.

Cercetarea în biologie cunoaşte o evoluţie spectaculoasă ca ştiinţă fundamentală şi se caracterizează prin dezvoltarea biologiei moleculare, în paralel cu dezvoltarea ecologiei.

- în perioada 1960-1970 se constată avântul biotehnologiilor;
- se utilizează microscopul cu raze UV pentru localizarea acizilor nucleici;
- utilzarea microscopului electronic în biologie a cerut 15 ani de căutări pentru a pune la punct metode specifice de fixare, secţionare, preparare;
- procedeele de cultură a ţesuturilor „in vitro" sunt intens folosite după 1970, deşi din 1939 **White** şi **Gautheret** obţinuseră deja rezultate,
- separarea organitelor celulare prin ultracentrifugare;
- folosirea izotopilor radioactivi;
- se descoperă (în 1953) structura spaţială a ADN de **Watson** şi **Crick**;
- se descoperă ribozomii de către **Palade**.

Aşadar, după cunoţtinţele acumulate în a doua jumătate a secolului al XX-lea, s-a remodelat teoria celulară.

a) dintr-un obiect de studiu, celula devine un model de studiu;

b) raportul celulă-organim este bine stabilit, nefiind vorba de o subordonare, ci de o bifurcare;

c) ea integrează toate aspectele ce privesc studiul viului; ea stă la baza dezvoltării extraordinare a geneticii, microbiologiei şi neurologiei în ultimele decenii;

d) ea are atât o funcţie pedagogică (pentru a transmite o anumită organizare cunoaş-terii) şi un instrument prospectiv, destinat să orienteze şi să stimuleze cercetarea.

Orice biolog care se respectă trebuie să recunoască că nimic nu se poate înţelege din organizarea şi funcţionarea viului fără a înţelege structura şi funcţiile celulei.

Bibliografie selectivă

1. BUVAT R., 1969 - *La cellule végétale*. În colecţia „l' Univers des Connaissances", Éd. Hachette, Paris
2. FIRKET H., 1962-*La cellule vivante*. În colecţia „Que sais-je?", Éd. Presses Universitaires de France, Paris
3. GIORDAN A., 1987 - *Histoire de la Biologie*, 2: Éd. Technique et Documen-tation - Lavoisier, Paris
4. HENNEGUY L. F., 1896-*Leçons sur la cellule. Morphologie et reproduction*. Éd. G. Carré, Paris
5. PILET P. E., 1968 - *La cellule (structure et fonctions)*. Éd. Masson et C ie, Paris
6. TOMA C.,NIŢĂ M., 1995 - *Celula vegetală*. Ed. Univ. „Al. I. Cuza", Iaşi
7. WASTIAUX G., 1994 - *La microscopie optique moderne*. Éd. Technique et Documentation -Lavoisier, Paris

Opere de început

1. HOOKE (1635-1703) - *Micrographia*, 1667.
2. GREW, 1672 (după BUVAT:1671 - 682)- *Anatomy of Vegetables Begun*.
3. MALPIGHI - *Opera omnia*, 1675, 1679 (după BUVAT:1671 - 1687)
4. LEEUWENHOECK (1632 - 1723)-*Opera omnia* (4 volume), 1715-1719.
5. DUTROCHET (1776-1847) - *Mémoire pour servir à l'histoire anatomique et physiologique des végétaux et des animaux*, 1837.
6. SCHLEIDEN (1804 - 1881) - *Beiträge zur Phytogenesis* (trad. franç. in Ann. J. Bot., 11, 1839).
7. SCHWANN (1810- 1882)-*Microscopische Untersuchungen*, 1839.
8. VIRCHOW (1821 - 1902) - *Pathologie cellulaire*, 1859.

Fig. 1 - Microscopul lui Leeuwenhoek (Buvat, 1969)

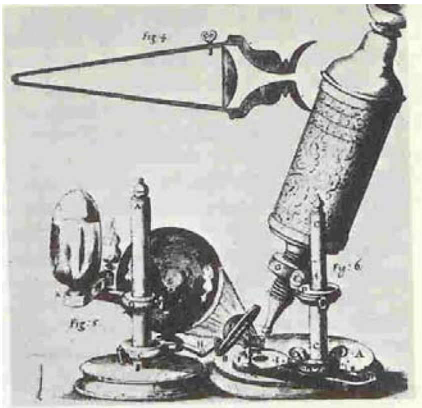

Fig. 2 - Microscopul lui Hooke (Buvat, 1969)

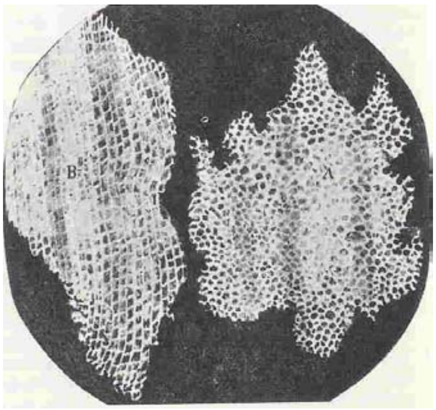

Fig. 3 - Primul desen al unui țesut vegetal (plută, suber) realizat de R. Hooke (Buvat, 1969)

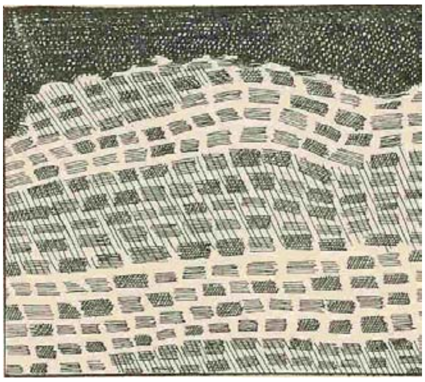

Fig. 4 - Facsimil al unui fragment dintr – o planşă aparținând lui R. Hooke, 1667 (secțiune prin suber) (Henneguy, 1896).

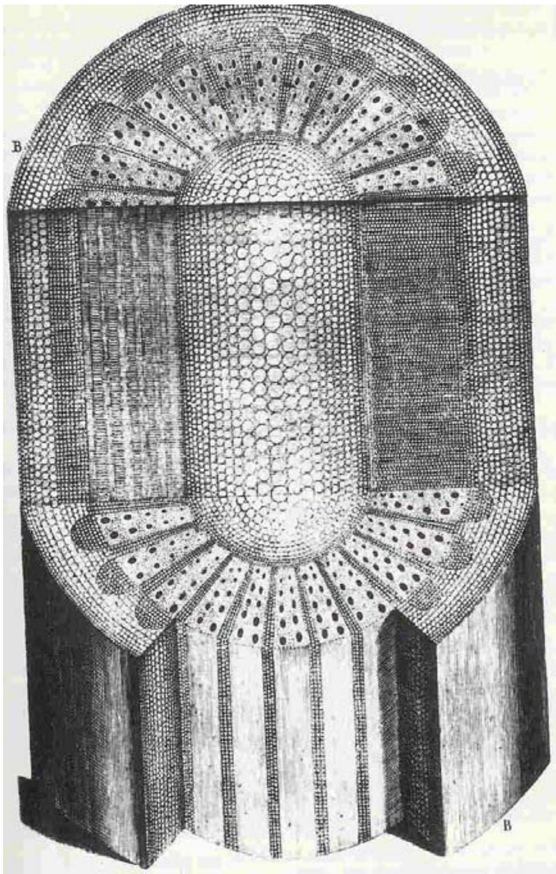

Fig. 5 - Una din cele 83 de planşe gravate în cupru, din lucrarea lui Grew, *The Anatomy of Plants* (secțiuni transversală şi longitudinal mediană printr-o tulpină de viță de vie) (Buvat, 1969).

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ORHIDEELE - O LUME APARTE
Referat

CONSTANTIN TOMA,
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ABSTRACT

TOMA C., GOSTIN I. , 2006 - The Orchids – a special world. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol.21: 20-26.

The authors present the morphological characters of the orchids, the general aspect, the structure of the flower and mimesis of some species, the insects which pollinate them and the reciprocal adaptations, the relationships with the micorisant fungi, the distribution of the Globe, the culture of the orchids and the actions carried aut by human being for their protection.

Key words: orchids, morphology, adaptation.

În societatea noastră tehnologică, dedată cultului pentru automobil, pentru video şi computer, care pătrund astăzi până şi în celula familială, fiinţa umană simte confuz că-şi pierde stăpânirea asupra lumii. Din instinct, omul încearcă să reia legătura cu **Natura.** Orhideele îi dau, fără îndoială, mijlocul cel mai fascinant pentru a o face.

De ce titlul *“Orhideele - o lume aparte”* ?

- Orhideele reprezintă cea mai mare familie de plante cu flori (între 20.000 şi 30.000 de specii, incluzând aici şi numeroşi hibrizi interspecifici şi chiar intergenerici).

- Orhideele au cea mai frumoasă floare, neîntrecută ca formă, culoare şi, uneori, miros de nici o altă specie de plante.

- Orhideele au cele mai sofisticate şi mai curioase adaptări pentru atragerea insectelor polenizatoare.

- Orhideele cuprind cele mai multe specii ocrotite prin lege, mai ales în zonele tropicale şi subtropicale, dar şi la noi, dacă ne referim la papucul doamnei - *Cypripedium calceolus* şi la sângele voinicului - *Nigritella nigra* şi *Nigritella rubra*.

- Orhideele au atras în toate timpurile atenţia oamenilor. De îndată ce au fost cunoscute, ele au dezlănţuit pasiuni, au făcut să se nască fantasme. Sunt “florile” care i-au impresionat cel mai mult pe scriitori, pe poeţi în mod deosebit.

- Se poate vorbi, în cazul orhideelor, de paradis şi infern în acelaşi timp. Chinezii cunoşteau orhideele cu 6 secole înainte de Hristos. Confucius scria că “orhideea este parfumul suprem, demn de un rege”. Popoarele orientale cântau parfumul şi frumuseţea somptuoasă a orhi-deelor. Astfel, *Dendrobium moniliforme* era la modă în Japonia încă din antichitate pentru parfumul său subtil “care dădea viaţă oamenilor”. La popoarele din America tot frumuseţea conta cel mai mult. Specia *Sobralia dichotoma* a primit numele de “floarea paradisului” în Peru. Mai multe popoare ale Americii numesc orhideele epifite “fiice ale aerului”. În Mexic, specia *Laelia acuminata,* albă şi parfumată, se numeşte “floarea lui Iisus”. În Guatemala, renumita *Cattleya* este “floarea Sfântului Sebastian”. Nici ţinuturile europene n-au rămas mai în urmă; cea mai celebră orhidee a noastră, *Cypripedium calceolus,* este cunoscută sub numele de “sabotul lui Venus”, “papucul fecioarei” sau “papucul doamnei”.

- Începând din anul 1954, din 3 în 3 ani se organizează “Conferinţa Mondială a Orhideelor” (în 1975 am participat şi noi, la Frankfurt pe Main, cu o lucrarea referitoare la orhideele spontane din România). Din acelaşi an, iubitorii de orhidee fondează societăţi de orhido-filie, se organizează primele expoziţii naţionale, apoi internaţionale de orhidee, care atrag din ce în ce mai mulţi iubitori de frumos.

Dacă în Europa, florile tăiate, de orhidee bineînţeles, sunt exportate mai cu seamă de Olanda, iar cele în ghiveci provin îndeosebi din Tailanda, în S.U.A. există sute de producători de orhidee, organizaţi în peste 500 de societăţi de stat sau de amatori. Suprafeţele de expoziţie

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prilejuite de amintitele conferințe mondiale sunt în continuă creştere, ca şi numărul de vizitatori: la Frankfurt pe Main - 200.000, la Bangkok - 300.000, la Miami - 500.000 şi numărul lor este în continuă creştere, ceea ce atestă interesul mereu crescând față de aceste plante; flori tăiate de orhidee sunt tot mai prezente şi pe piețele noastre, cel puțin în ultimii 20-25 ani.

Mari amatori de orhidee, colecționari pasionați, americanii nu sunt, totuşi, cei mai mari producători de orhidee; ei sunt precedați de olandezi şi tailandezi; Olanda, cea care deține supremația în această privință (ca şi pentru lalele, cum bine se cunoaşte), numără aproximativ 300 de producători, ce au suprafața de sere variind între 1000 şi 30.000 m^2; în exploatările cele mai vaste sunt cultivate până la 300.000 de plante. Tailanda produce tot atâtea orhidee cât şi Olanda, dar în condiții de cultură mai uşoare, în general sub adăpost, dar fără sere. La rând vin Anglia, Germania, Franța şi Italia, țări care au avut şi au, de asemenea, un adevărat cult pentru orhidee. In felul acesta creşte continuu gustul pentru orhidee, în asemenea măsură încât uneori câştigă în fața tradiționalului trandafir.

Dacă din toate timpurile orhideele l-au condus pe om să utilizeze un limbaj dublu, trebuie să spunem, totuşi, că acela al frumuseții a fost întotdeauna mai tare. De aceea, îndată ce primele **orhidee exotice** au fost cunoscute în Europa, ele au provocat admirație, au declanşat pasiuni, ridicând febra până la marginea catastrofei.

Bineînțeles, cei care au descoperit primele orhidee tropicale au fost călătorii, în secolele 16 şi 17. In anul 1731 sunt introduse în Europa primele orhidee exotice; dar abia în 1818, prima orhidee adusă în Europa înfloreşte şi i se dă numele de *Cattleya.* In Europa, apoi în S.U.A., pasiunea pentru orhidee creşte. Colecții costisitoare se constituie într-un climat de supraexcitare. Acum se construiesc primele sere.

Astfel începe vânătoarea de orhidee şi capătă aspectul unui adevărat jaf. Numărul culegătorilor creşte vertiginos. Amatorii sunt repede îndepărtați de profesionişti, atraşi de momeala unor câştiguri fabuloase. Numărul exemplarelor colectate creşte vertiginos. Căutările se făceau în adâncurile junglei, dar unde înaintarea era dificilă. Într-o expediție se ajungea la colectarea unui număr de 40.000-50.000 de exemplare, pentru care însă trebuia organizat transportul.

Multe expediții eşuau, culegătorii mureau de friguri galbene. Majoritatea plantelor recoltate, despre orhidee este vorba, putrezeau în timpul transportului îndelungat cu vaporul. Cum în acea vreme nici un vas cu aburi nu tranversase încă oceanul, bietele orhidee au trebuit să efectueze călătoria pe mare în fundul calei unui vas cu pânze, după care aşteptau mai mult de o lună ocazia pentru un port mai apropiat de destinația lor. Îngrămădite ca nişte heringi în butoi, au fost nenorocite de căldură şi fermentație, astfel încât nu au ajuns la destinație; şi nu câteva, ci 40.000-50.000 de exemplare.

Dacă, totuşi, unele ajungeau în Europa sau în S.U.A., ele erau vândute la prețuri foarte mari, utilizând sistemul licitației; un exemplar putea ajunge la 500.000 de franci. În mod curent, însă, un exemplar ajungea până la 5000 de franci pe la 1840 (fără să uităm că salariul lunar al unui funcționar de rând era 30 de franci).

Războiul din 1914-1918 dă, însă, o lovitură grea speculei şi modei orhideelor; prețurile cunosc un veritabil reflux şi aceasta datorită succeselor obținute în cultura orhideelor, datorate lui Noel Bernard, şi în multiplicarea "in vitro", de către Georges Morel. Aşa se cultivă *astăzi,* pe scară întinsă, specii de *Cattleya, Phalaenopsis* sau *Cymbidium,* care au devenit familiare orhidofililor.

Când, la sfârşitul secolului 19, primii colecționari primeau orhidee tropicale, ei le cultivau, adesea, într-un mediu neadecvat şi de aceea piereau în cele mai multe din cazuri. Serele erau încălzite cu sobe care degajau oxidul de carbon, gaz letal pentru plante atunci când este în exces. Absența aerisirii şi stropirea exagerată determinau o atmosferă caldă şi excesiv de umedă, care nu era comparabilă cu atmosfera proaspătă, umedă şi aerisită a munților ecuatoriali sau tropicali de unde proveneau orhideele; ele putrezeau. Orhideele epifite erau adesea plantate în vase umplute cu pământ, în timp ce ele trăiesc *agățate* de ramurile arborilor, suspendându-şi rădăcinile aeriene ce absorb substanțele nutritive din apa de ploaie şi din resturile de frunze descompuse, ce rămân pe scoarță. "A cultiva epifite într-un vas obişnuit, cu un sol obişnuit, scria un mare botanist francez (Julien Costantin), este de fapt la fel de monstruos ca şi atunci când ai vrea să creşti peşti în afara apei, care este mediul lor natural".

Cuvântul **orhidee** evocă celor mai mulți o floare somptuoasă, ce emană un parfum îmbătător, care-ți trimite gândul în ținuturi exotice. In Europa, însă, orhideele sunt nişte plante discrete, destul de rar întâlnite, cu port elegant şi flori foarte diferit colorate.

Orhideele constituie o familie foarte bogată în specii (20.000-30.000), reprezentând 10% din totalul speciilor de plante cu flori de pe Terra. Peste 90% dintre ele cresc în regiunile tropicale din Asia, Africa şi America de Sud. în pădurile ombrofile tropicale, caracterizate prin precipitații supraabundente, aer saturat în umiditate, prosperă speciile **epifite,** cu rădăcini suspendate; lungile lor tulpini se cațără până în vârful arborilor în căutarea luminii solare; ele sunt articulate şi articulele caulinare sunt transformate în **tuberculi caulinari.** La speciile **terestre,** cu tulpini mult mai scurte, substanțele de rezervă necesare creşterii şi dezvoltării noilor generaţii se acumulează în **tuberculii radiculari** (uneori micşti) subterani.

Rădăcinile multor specii trăiesc în simbioză cu filamentele unor ciuperci, rezultând **endomicorize,** care asigură schimburile de substanţe hrănitoare între mediu şi plantă; la speciile clorofiliene, micoriza asigură o hrănire suplimentară, în timp ce la cele neclorofiliene ea reprezintă singura posibilitate de a se hrăni.

Orhideele reprezintă un grup de plante relativ tânăr (strămoşii lor tereştri existau acum 50-60 milioane de ani) şi foarte evoluat, primele fosile fiind descoperite în bazinul mediteraneean şi în China. Trecerea la viaţa epifită ar fi avut loc mult mai târziu (în urmă cu 5-6 milioane de ani). Astăzi, orhideele se află în plin progres, ceea ce se traduce în natură, între altele, prin apariţia spontană a unui mare număr de **hibrizi** interspecifici şi chiar intergenerici.

Numeroase scrieri greceşti menţionează existenţa orhideelor sub numele de **orchis,** cuvânt care semnifică testicul, cu referire la forma celor doi tuberculi radiculari (egali sau inegali) existenţi la cele mai multe specii terestre.

Dimensiunile orhideelor *variază* foarte mult: de la 2 cm (*Lepanthes,* cu floarea de 4 mm), până la peste 3 m (aşa cum este regele orhideelor - *Gramatophyllum speciosum* din Malaiezia, cu floarea de 20 cm; florile sunt dispuse în 14 raceme, fiecare cu aproximativ 100 de flori), iar în cazul lianelor epifite (precum vanilia - *Vanilia planifolia*), tulpina depăşeşte 30 m lungime.

Orhideele sunt spectaculoase prin forma, culoarea şi parfumul florilor, prin marea diversitate de adaptări la diferite medii şi la polenizarea cu ajutorul insectelor: unele sunt **epifite** (trăind pe alte plante, în pădurile calde şi umede, tropicale şi subtropicale), altele **litofite** (trăind pe pietre), cum sunt cele tropicale; speciile ce cresc în Europa (deci în climatul temperat) sunt **terestre.**

Dimensiunile şi diversitatea de forme i-a făcut pe oameni să vadă în orhidee, în funcţie de dispoziţia, inspiraţia şi imaginaţia fiecăruia, fie flori ale paradisului (precum *Sobralia dichotoma*), fie monştri otrăviţi (ca *Himantoglossum hircinum).*

Majoritatea orhideelor sunt autotrofe; puţine sunt heterotrofe saprofite, lipsite de clorofilă, precum *Neottia nidus-avis* - cuibuşorul (numit aşa datorită rădăcinilor încâlcite în formă de cuib) şi *Corallorhiza innata* («rădăcinile» ei, de fapt rizomul ramificat, amintind de forma coralilor).

Şi totuşi, aceste plante care „au ştiut" să se adapteze atât de bine pentru a supravieţui, pentru a-şi asigura polenizarea cu ajutorul insectelor, au făcut dovada unei slabe imaginaţii în ceea ce priveşte **sămânţa:** aceasta este extrem de mică (abia vizibilă cu ochiul liber), cu embrion redus (fără radiculă) şi fără albumen, deci incapabilă să germineze (fiind lipsită de rezerve nutritive); intervine atunci ajutorul miceliului unei ciuperci pentru a-i aduce hrană şi pentru ca minuscula sămânţă să devină o atât de frumoasă plantă.

Trăsăturile morfologice ale orhideelor

Toate orhideele sunt plante ierbacee, perene, din grupa angiospermelor monocotiledonate, având în sol tulpini şi rădăcini metamorfozate dacă sunt terestre (rizomi, tuberculi), având în aer tulpini căţărătoare prin spini sau cârcei radiculari, tuberculi caulinari, bulbi foliari şi rădăcini aeriene dacă ne referim la epifite.

- rizomi: *Cypripedium, Listera, Cephalanthera, Epipactis, Neottia, Corallorhiza* ş.a.;
- tuberculi: egali sau inegali, globuloşi *(Orchis, Ophris* ş.a.) sau palmat-divizaţi (*Nigritella, Dactylorhiza*);
- bulbi: foliari, lungi *(Bulbophyllum)*;
- rădăcini: adventive, cilindrice, fie aeriene transformate în spini *(Vanilla*), fie aeriene suspendate, cu velamen (la epifite - *Stanhopea, Dendrobium*), fie tuberizate (un fascicul de rădăcini cu o scoarţă comună şi mai multe steluri – *Orchis*); rădăcinile lipsesc la *Corallorhiza, Epipogium;* uneori sunt asimilatoare, late: *Taeniophyllum, Chiloschista lamifera* (cu lăstari şi frunze reduse);
- tulpina aeriană: erectă şi neramificată la speciile terestre, ascendentă sau urcătoare la cele epifite;
- frunze: alterne, întregi, sesile, cu nervaţiune paralelă sau arcuată, uneori verzi, alteori pătate în nuanţe brune sau purpurii; mai rar sunt reduse la scvame gălbui sau brune (*Neottia*);
- florile: hermafrodite şi zigomorfe (cu simetrie bilaterală), răsturnate din cauza răsucirii cu 180° a pedicelului sau a ovarului; uneori sunt solitare (*Cypripedium),* dar cel mai adesea sunt grupate în inflorescenţe racemoase sau paniculate.

Floarea este pe tipul 3, cu:

- perigon petaloid, mai adesea cu 6 tepale, libere sau concrescute la bază:
  - 3 externe
  - 2 laterale mici
  - 1 internă, mediană, superioară, foarte mare, numită **labelum,** foarte diferită de celelalte, care se continuă la bază cu un pinten sau cu o dilatare saciformă (excavaţie);
- androceu: 3 (6) stamine - 1 fertilă (2 la *Cypripedium)* şi 2 sterile, reduse la staminodii;
  - filamentele staminelor sunt unite cu stilul gineceului, formând o coloană = **ginostemium,** care are în vârf antera staminei fertile şi stigmatul trilobat (doar cel madian este steril - **rostelum,** cu un fel de

buză ce împiedică complet comunicarea cu anterele); rostelul are o excavație numită **bursiculă,** în care se fixează **retinaclul** (piesa bazală vâscoasă ce uneşte baza poliniilor pedicelate);
- polenul din fiecare lojă a anterei este aglutinat într-o masă compactă - **polinie** pedicelată; cele 2 polinii (în formă de rachetă) sunt unite la baza pedicelilor (numiți **caudiculi)** printr-o piesă vâscoasă - **retinaclu** (unit cu stigmatul), ce se fixează în **bursiculă** (excavație a lobului stigmatic median);

- gineceu: 3 carpele unite, cu ovar răsucit cu 180°, stil unit cu filamentele staminelor, stigmat trilobat;
- polenizare: prin insecte (plante entomofile);
- fecundație: sifonogamie dublă (proprie tuturor angiospermelor);
- fruct uscat: capsulă dehiscentă în 3 valve (are lungimea de 20 cm la vanilie);
- sămânța: foarte mică; într-o capsulă se află numeroase semințe; embrionul este incomplet dezvoltat (fără radiculă) şi este lipsită de albumen.

Singura posibilitate ca din embrion să se dezvolte o nouă plantă este ca filamentul unei ciuperci micorizante să-l penetreze şi să-i ducă hrana necesară pentru germinare şi creşterea inițială.

Numărul enorm de mare de semințe este o şansă în plus de întâlnire dintre ele şi ciupercile simbionte. De aceea există şi atâtea adaptări incredibile ale florii la polenizarea prin insecte.

Rostelul, scria Darwin în 1870, apare în evoluție ca un organ nou, specializat pentru polenizarea cu ajutorul insectelor; este un organ activ, care se "sacrifică" autodistrugându-se parțial în momentul în care poliniile au fost smulse de la baza lui, pentru a se lipi de capul sau trompa insectei ce a pătruns în floare.

Dintre regiunile cele mai bogate în orhidee menționăm Asia de Sud-Est, America de Sud (tropicală) şi America Centrală. În tundră cresc 3-5 specii, în taiga 10-12 specii, în pădurile şi preriile din zona temperată a Americii de Nord 200 specii, în zona tropicală umedă 5000-6000 şepcii, în pădurile umede montane din Costa Rica 900 specii *(Cattleya skineri,* epifită, reprezentând floarea ei națională), în Europa: 100 specii (toate terestre); în România, mai mult sau mai puțin 50 de specii (toate terestre).

Portul orhideelor

Se cunosc orhidee cu port **monopodial,** ce produc lăstari care pleacă direct din tulpina principală (*Vandă, Angraecum*) şi orhidee cu port **simpodial,** care produc mai mulți lăstari pe rizom *(Cattleya, Dendrobium*).

Se cunosc plante:
- **afile,** care limitează astfel transpirația, rezistând la perioadele de secetă (*Dendrophyllax, Chiloschista, Campylocentrum*);
- **cu frunze foarte groase,** cilindrice, care rezistă mai bine la insolație, limitând astfel evaporația (*Scuticaria steelei*);
- **care își pierd frunzele la sosirea sezonului urât** (fug de secetă).

Adaptări la polenizarea încrucişată cu ajutorul insectelor, şi mai rar, a păsărilor.

Orhideele se polenizează cu ajutorul fluturilor (lepidopterelor), muştelor (dipterelor), himenopterelor (viespi, albine, bondari), coleopterelor (gândacilor).

Ele produc, în final, un mare număr de semințe pe individ: 24.000 *(Cephalanthera)* până la 186.300 (*Orchis maculată*).

Orhideele sugerează un „minunat amestec de fantastic şi real, de atracție şi repulsie în acelaşi timp față de polenizatori".

Relațiile om-orhidee evocă toate formele unei relații amoroase: căutare, posesie, amor captiv şi exclusiv, uneori chinuitor, descoperire progresivă a respectului datorat acestor plante extraordinare; vis inaccesibil, farmec, vrajă, tentative de apropiere, de seducție şi de posesiune, cuvânt magic, admirație, groază, ciudățenie, mister, sfințenie, exotism şi esoterism, cultură ce relevă bravură, o ciudățenie care îi conferă o imaterialitate, o transcendență a lucrurilor terestre.

În mod paradoxal şi spre deosebire de toate celelalte familii de plante, bogăția în specii contrastează cu raritatea, uneori extremă, cu care ele sunt reprezentate în natură. Contrar unei logici curent răspândite, succesul lor în natură nu ține nici de numărul de reprezentanți, nici de tendința lor de a înlocui plantele învecinate. Hiperadaptarea lor la diferite medii le-a făcut dependente de condițiile climatice şi biologice ale acestora: umiditate, lumină, ciclul de ploi şi de temperatură, tipul de insecte polenizatoare, de ciupercă micorizantă care favorizează germinarea semințelor.

Tipul de floare „**animalizată**" este unic printre plante, reuşind să "mimeze" un animal până în cele mai mici detalii. Această adaptare are ca scop reproducerea speciei şi nu are nimic defensiv sau ofensiv; prin acest mimetism orhideele realizează indiscutabil "un plus de viață".

Labelul florii poate fi în formă de sabot, liguliform, lobat şi divizat, bombat sau plat, marginile sale putând fi netede, crenelate, ridicate în sus sau lăsate în jos. El poate purta puncte, pete, desene de tot felul, mai mici sau mai mari. El poate avea aproape toate culorile, toate nuanțele posibile. Suprafața sa este glabră, ciliată sau catifelată. Adesea, labelul se prelungeşte spre îndărăt printr-un **pinten,** gros sau subțire, în formă de sac, scurt sau lung, drept sau curbat, orizontal ori îndrepat în sus sau în jos, umplut cel puțin în parte cu **nectar**.

La orhideele de tip **sabot** (*Cypripedium, Paphiopedilum*), insecta în căutare de nectar alunecă sub ginostemium şi nu iese decât după ce s-a strecurat pe laturile acestuia, aducând poliniile lipite pe spatele ei; această mişcare împiedică autopolenizarea. O dată cu vizita unei alte flori, insecta va depune poliniile pe stigmat înainte de a ieşi, purtătoare a unei noi încărcături de polen. Se vorbeşte în acest caz de polenizare folosind strategia de **capcană**.

La multe orhidee, relația insectă-orhidee este atât de intim stabilită încât putem vorbi de "fidelitate" sau de "restricție", pentru că numai insecta capabilă de a poleniza eficace va putea vizita floarea şi obține recompensa în nectar.

Deoarece polenul orhideelor, grupat în polinii, nu este folosit de albine ca sursă de hrană, principala sursă de recompensă constă în **nectar.** Orhideele la care această adaptare este prezentă cel mai evident, sunt acelea prevăzute cu un **pinten** în fundul labelului. Insecta trebuie atunci să fie prevăzută cu un **apendice** pentru a putea lua nectarul şi, făcând aşa, ea se umple cu **polinii.** Exemplul cel mai notabil este *Angraecum sesquipedale,* de care s-a interesat Darwin, care în 1862 avea să prezică, văzând pintenul lung de peste 30 cm al acestei orhidee malgaşe, existența unui fluture cu o trompă de asmenea lungă; această insectă nocturnă, atunci necunoscută, a fost descoperită cu 41 de ani mai târziu şi numită *Xanthophan morgani praedicta.*

O situație asemănătoare întâlnim la *Habenaria,* polenizată tot de un fluture cu trompă lungă.

În cazul speciei *Calypso bulbosa,* vorbim de un <u>pseudopolen</u> şi, deci, de <u>decepția</u> polenizatorului. Prin consistența sa, seamănă cu polenul comestibil pentru polenizator: această substanță este mâncată de albine. Uneori, pe labelul florilor de *Maxillaria* se află <u>ceară,</u> care ar putea fi utilizată de albine în construcția „cuiburilor" (fagurilor). Se mai întâmplă ca anumite orhidee să pară că promit nectar, dar pe care nu-l produc. Câteva specii, precum cele de *Calypso* (ce cresc în turbării), au peri galbeni uniți într-o egretă ce mimează poliniile.

Plantele care prezintă **piese mobile** în alcătuirea florii suscită totdeauna curiozitate. Te gândeşti imediat la **capcanele** active ale plantelor carnivore. Deşi la orhidee mişcarea este mai ales pasivă, mobilitatea unor piese florale în vederea unei polenizări mai eficace este foarte interesantă. Astfel, **labelul** mai multor orhidee se apleacă sub greutatea polenizatorului, favorizând astfel depunerea poliniilor sau colectarea lor. Specii de *Pleurothallis* au peri sau apendici care se deplasează la adierea vântului, atrăgând îndeosebi muştele. La genul *Porroglossum,* şi nu numai, mişcarea labelului spre ginostemium se face cu o aşa presiune pe partea lui bazală, încât insecta este astfel închisă şi singura ieşire posibilă trebuie s-o facă ca să treacă prin stigmat, apoi rostelum, unde ea depune poliniile cu care intrase. După câteva minute labelul îşi reia poziția sa inițială, aşteptând următoarea sa „victimă".

Mişcarea de ejecție a poliniilor de către *Catasetum* este impresionantă, declanşată din moment ce atingi vârful unui creion pe micile antene din apropierea retinaclului; acesta din urmă aderă într-un mod remarcabil, până ce se debarasează cu vigoare, transferând poliniile pe stigmatul altei flori. Florile de *Catasetum* nu produc nectar, produc puțin polen şi nu sunt vizitate decât de masculii unor specii de albine. Motivul: mirosul atrage aceste insecte şi masculii colectează uleiul aromatic secretat de flori şi-l depun într-un şanț al tibiilor posterioare (cu țesut spongios, chitinos); acest ulei are rol de marcaj al teritoriului în timpul zborurilor nupțiale (ceea ce este comparabil cu ritualul de desfăşurare a culorilor la păsările-paradis, când masculii se reunesc pentru a atrage femelele); aşadar, la insecte mirosul înlocuieşte culorile.

<u>Mimetismul</u> este unul din fenomenele cele mai fascinante din regnul vegetal. Speciile de *Bulbophyllum* atrag muştele prin flori. Muştele, când ling o secreție agreabilă, când sunt atrase de un miros înşelător, căci floarea nu are nimic altceva de oferit decât **iluzii.** Numeroase specii mimează florile unor plante atrăgătoare pentru polenizatori: *Cephalanthera rubra* mimează o campanulă bogată în nectar. O albină masculă polenizează speciile de *Oncidium* „atacând" inflorescența care mimează un alt mascul în zbor; „crezând" că vibrațiile orhideelor constituie un rival ce vizitează teritoriul lor, se năpustesc în floare şi acroşează astfel poliniile pe capul lor. În acest caz, nici mirosul, nici hrana, nici culoarea nu sunt în joc, ci doar apărarea teritoriului de către insectă. Zburând în altă floare, masculii transportă şi depun poliniile luate.

Dar, poate şi mai interesant este fenomenul de <u>pseudocopulație.</u> În totalitate sau parțial, floarea mimează femela unei specii de insecte. Ea va fi atunci *vizitată* de masculii aflați în zbor în căutarea unei femele. Speciile de *Trichoceros* mimează cu ajutorul perilor şi pieselor florale mobile femela unei muşte. Unele orhidee, precum cele din genul *Ophrys,* fără nectar, fără parfum, fără alte substanțe comestibile, s-au transformat în <u>**"prostituate"**</u> au mimat o femelă de insectă şi sunt polenizate de diverse himenoptere, care practic se „masturbează" pe această „femelă – floare" (floarea partener sexual). La aceste orhidee, labelul florii aminteşte prin formă, culoare, catifelare corpul unei insecte femele. *Ophris apifera* din Anglia se autopolenizează, deoarece şi-a pierdut polenizatorul seducător sau „partenerul" său sexual. Este o **acuplare** insectă-floare şi are loc numai cu masculii foarte tineri (de curând eclozați), când femelele speciei sunt încă foarte rare. Stimularea primară este olfactivă (datorită

feromonilor produşi de floare), urmată de stimularea tactilă şi de cea vizuală. Labelul are pseudoochi, pseudoantene, pseudoaripi, peri, culoare, textură asemănătoare cu cele de la femela insectei. **Atracția** adevărată pentru insectă rezultă din mirosul asemănător celui al femelei - un veritabil feromon mimetic, secretat de plantă; atât de puternic este feromonul, încât unii masculi preferă floarea în locul femelei.

Totuşi, orhideea nu este destul de confortabilă pentru insecta-mascul (partenerul său „amoros") şi, deşi penisul ar ieşi şi s-ar freca de label, nu are loc ejacularea. Pentru aceste orhidee, care nu au nimic de oferit, soluția lor „erotică" este unica lor şansă de a supraviețui, polenizarea încrucişată fiind o necesitate pentru ele.

Alte soluții amintesc de plantele carnivore: insectele, amețite de un țesut odorant, cad în lichidul din excavația labelului, le poartă o picătură până la polen sau la stigmat; prima insectă are dificultăți cu rostelul la ieşire, dar celelalte scapă mai uşor, îmbăiate cu polen şi nectar, dar care au făcut polenizarea. Dacă insecta stă prea mult, floarea opreşte mirosul, pe care-l reia a doua zi, evitându-se autopolenizarea.

Culorile florilor, pe care le percepem noi, sunt complet diferite de cele percepute de insecte şi păsări. **Albastrul,** violetul, purpuriul, galbenul şi albul acționează mai mult asupra albinelor. **Roşul aprins** va atrage mai ales păsările. **Forma labelului,** şi nu numai, are atât rol mimetic, în pseudo-copulare, cât şi ca psită de aterizare pentru insectele polenizatoare; păsările au o mai mare uşurință în a lua nectarul cu ciocul lor dintr-o floare tubulară.

Aşadar, orhideele prezintă adaptări din cele mai diferite, care privesc morfologia florii şi comportamentul insectelor care le asigură polenizarea. O asemenea specializare este indispensabilă pentru a asigura eficacitatea transportului polenului de către insecte. Strategiile de atracție merg de la mutualism la parazitism comportamental (momeli nutritive sau sexuale). Dintre **sindroamele** de polenizare reamintim:

- **fluture nocturn:** flori necolorate (albe până la verzui sau cu dungi verzui); miros puternic emis seara; label strâmt, îngust şi pendent (fluturii nocturni, ce se hrănesc în zbor staționar, nu au nevoie de o platformă de repaos); nectar disimulat într-un tub lung şi strâmt (pintenul), accesibil trompelor lungi ale fluturilor; de ex. specii de *Platanthera.* bazat pe acest sindrom Darwin avea să prezică existenta unui fluture cu trompă lungă (necunoscut încă) care să polenizeze pe *Angraecum sesquipedale*;
- **fluture diurn:** flori viu colorate (roz, roşu), miros proaspăt şi agreabil emis în plină zi; label mai mult sau mai puțin orizontal, ce serveşte de platformă de aterizare; nectar disimulat într-un pinten; de ex., *Gymnadenia conopsea*;
- **viespe:** flori verzi, roşiatice sau brune; label ce poate servi ca platformă de aterizare; nectar uşor accesibil; de ex., *Listera ovata, Epipactis palustris*;
- **albină:** flori colorate în roşu închis, galben sau alb; prezență de ghizi spre nectar; miros proaspăt şi dulce; label ce poate servi de platformă de aterizare; nectar mai mult sau mai puțin disimulat; de ex., *Orchis maculata.*

Dintre toate orhideele, una este alimentar-condimentară:*Vanilla* (vanilia). Genul *Vanilla* cuprinde 60 de specii, cea mai des cultivată fiind *V. planifolia.* Vanilia, utilizată începând cu 1000 de ani în urmă, este al doilea, ca preț, condiment din lume. Dar, să nu uităm că în comerț este **zahăr** vanilat sau vanilinat, vanilina fiind o subtanță sintetică.

Vanilia a fost adusă în Europa la 1518, utilizată la curtea spaniolă pentru o băutură: ciocolată cu vanilie. De la 1602 este folosită drept condiment. În 1836, G. Morel a descoperit insecta polenizatoare (Melipona - albină) (adusă din Mexic), care în Europa nu a supraviețuit. Dar chiar şi în regiunile de origine se face polenizarea artificială manuală; chiar în Mexic, doar l din 100 de flori este polenizată de către o insectă (dipteră).

Vanilla planifolia, originară din Mexic, este o epifită - liană, lungă de până la 30 m, cu frunze lungi de 12 cm, cu rădăcini aeriene fixatoare (cu velamen) şi înfaşurătoare pe ramurile arborilor. Perioada de înflorire: 24 de zile (în fiecare inflorescență apare câte o floare pe zi).

Când se cultivă, se înrădăcinează în sol şi devine liană pe spalieri. **Fructul,** lung până la 20 cm, se maturează în 8-9 luni, reprezentând capsule numite batoane (cilindrice), plină cu numeroase semințe extrem de mici. Fructele, inițial verzi, se brunifică după 6-7 luni de la fecundație; ele se recoltează înainte de maturarea completă, se introduc în apă fierbinte 1-3 minute, se expun la soare câteva ore, se usucă pe cuverturi de lână, întreaga operație durând 1-2 luni. De înțeles, atunci, de ce batoanele de vanilie naturală sunt foarte scumpe (în comparație cu zahărul vanilinat).

Principiul aromatic esențial este **vanillina,** care cristalizează în ace fine, incolore.

În încheiere, reamintim faptul că primul hibrid de orhidee a fost obținut în 1856, în urma încrucişării a 2 specii de *Calanthe,* în Anglia. Principala dificultate era de a face să germineze minusculele semințe obținute prin polenizare şi fecundație artificială. Abia la începutul sec. 20, Noel Bernard descoperă necesara prezență a unei **ciuperci** care permite seminței să germineze şi să se dezvolte. Convins că germinarea ar fi posibilă şi în absența ciupercii, **dacă** i se dă seminței ceea ce aceasta din urmă îi aduce, el întreprinde o serie de experiențe pe mediu zaharat şi obține primele plantule. Marele inconvenient era că trebuia aşteptat peste 4 ani pentru a vedea înflorit un *Phalaenopsis* şi până la 8 ani pentru o *Cattleya.*

Georges Morel, în 1955, descoperă mijlocul de a multiplica plante pe mediu gelozat, plecând de la meristeme din apexul caulinar. Spre deosebire de reproducerea prin seminţe, din care rezultă orhidee diferite una de alta, înmulţirea vegetativă (prin culturi "in vitro") permite obţinerea de plante identice, toate asemănătoare între ele şi nevirozate.

Aceasta este lumea fascinantă a orhideelor, simbol al frumuseţii desăvârşite, al parfumului de neegalat, al diversităţii de forme şi culori, pe care n-o poate întrece nici o altă grupă de plante. Este de datoria noastră, a tuturor, să ocrotim aceste plante, oriunde ar creşte ele, să cunoaştem modul cum se cultivă această rară "floare", splendoarea splendorilor, miraculoasa orhidee, care ne încântă, ne îmbie la meditaţie, ne bucură s-o primim ori s-o dăruim în orice împrejurare celor dragi.

Bibliografie

1. BELLONE N., 1984 – *Orcchidées en folie. Science et Vie.* La Nouvelle Botanique : 114-127.
2. CLEMENTS M.A., MUIR H., CRIBB P.J., 1986 – *A preliminary report on the symbiotic germination of european terrestrial orchids.* KEW Bulletin, **41**, 2 : 437-445.
3. DARWIN CH., 1870 – *De la fécondation des orchidées par les insectes et des bon résultats du croissement.* Éd. Reinwald, Paris.
4. DÉMARES M., 1997 – *Atlas des orchidées sauvages de Haute Normandie*. Soc. Franç. d'Orchidophilie, Paris.
5. JOLIVET P., 1983 – *Insectes et plantes (evolution parallèle et adaptations).* Bull. Soc. Linn. de Lyon (numéro special), 52[e] année, septembrie, 148 pages.
6. KRISA B., 1985 – *Encyclopédie des plantes à fleures*. Éd. Gründ, Paris.
7. LINE L., HODGE W.H., 1981 – *Die Wunderwelt der Pflanzen.* Fr. Enke Verlag, Stuttgart.
8. ONISEI T., 1999 – *Orhideele din Masivul Ceahlău*, Ed. Coresi, Bucureşti.
9. PANŢU Z., 1915 – *Orchidaceele din România.* Ed. Acad. Rom., Bucureşti.
10. PÂRVU C., 1991 – *Universul plantelor*, Ed. Encicl., Bucureşti.
11. PAUCĂ A., MORARIU I., BELDIE AL., 1972 – *Orchidaceae. În Flora R.S. România*, **12** : 646-770, Ed. Acad. Rom., Bucureşti.
12. PERROT E., PARIS R., 1971 – *Les plantes médicinales*. Éd. Presses Universitaires de France, Paris.
13. SIMIONESCU I., 1961 – *Flora României* (ediţia a 3-a). Ed. Tineretului, Bucureşti.
14. TOMA C., NIŢĂ M., 1996 – *Orchideele – din toate timpurile şi azi*. St. şi cerc. Muz. şt. nat. Piatra Neamţ, **8** : 139-144.
15. TOMA C., SÂRBU I., 1977 – *General considerations on the spontaneous orchids in Romania*. Proc. 8th Welt Orchideen – Konferenz, Palmengarten Frankfurt/Main, 10-17 April 1975 : 120-122.
16. TOMA C., TOMA I., 2004 – *Simbioza micoriziană*. Mem. Secţ. şt. Acad. Rom., ser. IV, **27**: 123-149 (Bucureşti, 2005).

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SPATIAL AND TEMPORAL DISTRIBUTION OF THE DIATOMS FROM THE IZVORU MUNTELUI – BICAZ LAKE, IN THE CONDITIONS OF THE 2005 YEAR

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ABSTRACT

DARABĂ M. O., MIRON Şt., 2006 – Spatial and temporal distribution of the diatoms from the Izvoru Muntelui-Bicaz lake, in the conditions of the 2005 year. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol.21: 27-34.

The research made in the year of 2005 in the Izvoru Muntelui – Bicaz Lake permetted to establish 8 representative sampling stations for the fitoplankton: Potoci Gulf, Ruginești Gulf, Buhalnița, Gulf, Hangu Gulf, Lake entrace, Izvorul Alb Gulf Secu Gulf. 46 taxa of diatoms were identified, which 9 represent centric diatoms, the others being pennat.

Key words: planktonic diatoms, centric diatoms, pennat diatoms, density.

Introduction

Most accumulation lakes are built for hydroenergetic purposes. The great level variations in accumulation lakes lead, as a consequence, to the limitation, and nearly total absence, of macrophytes development on the sea coast area. Due to the absence of macrophytes, within the ecosystem of accumulation lakes, the role of essential primary producer is assumed by the phytoplankton (BURIAN, 2002). In its turn, the phytoplankton of these lakes grows only on the surface layer, which is penetrated by light, with a photosynthetic value, corresponding to the photic zone. Starting with the first years of its construction (POPESCU and OLTEAN, 1963; CĂRĂUŞU, 1969), the research performed in the Bicaz Accumulation Lake has proved the existence of the following phytoplanktonic components: *Cyanobacteria*, *Euglenophyta*, *Pyrrophyta*, *Cryptophyta*, *Chrysophyta*, *Bacillariophyta*, *Chlorophyta*, *Conjugatophyta* and *Xanthophyta*. Diatoms represent more than half of them, followed by chlorophyceae, conjugates, chrysoficeae, cyanophyceae, euglenophyceae, dinophyceae, cryptophyceae and xanthophyceae.

Materials and methods

The study of the spatial and temporal distribution of diatoms began in the spring of 2005 and continues today. A number of 216 samples were take from the 8 representative stations for Izvoru Muntelui – Bicaz Lake (Fig. 1), from March to November each month; from each station were taken 3 samples from different depths using the bathometer in the photic zone. The photic zone was established by Secchi disc *2, 5 coefficient. The three depth profiles were: surface, half of the photic zone and the limit of the photic zone. A volume of 2 litters was taken from each depth profile and fixed and preserved in formaldehyde 5%. The concentration of the sample by sedimentation was made in the Laboratory of Limnology and Ecology of the Faculty of Biology at the Al. I. Cuza Universsity of Iaşi. The vide pompa was used for the elimination of the supernatant. The concentrated samples were mineralizated to eliminate the cells content.

The quantitative analysis were made in the Bürker-Türk lamer and qualitative analysis were made on preparate mount/lamella by 10 readings per sample to evoid the errors.

We had calculated the density and the similarity coefficient.

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Fig. 1 - Bicaz Lake: Potoci Gulf (1); Rugineşti Gulf (2); Buhalniţa Gulf (3); Hangu Gulf (4); Lake entrace (5); Izvorul Alb Gulf (6); Secu Gulf (7); Baraj (8)

Results and discussions

The qualitative composition of the phytoplankton in Izvoru Muntelui – Bicaz Lake revealed 241 taxa in the first 15 years of it's exsistence, more then half being diatoms. The study of the phytoplankton made in the first two years after the water flood permetted the identification of 78 taxaonomic units (wich 38 in the first year, 11 in the second and 29 were common for both years (POPESCU, OLTEAN, 1963). CĂRĂUŞ (1983) made an inventory of 123 taxa of diatoms in the first 15 years of the Izvoru Muntelui – Bicaz Lake wich 8 are centric diatoms, the other 115 taxa being pennate diatoms. Comparing the list of the identified taxa in the first 15 years of existence of Izvoru Muntelui – Bicaz Lake (MIRON and all. 1983) identified new taxa for this lake such as: *Cyclotella ocellata, Melosira roseana, Melosira granulata*, *Stephanodiscus dubius; Coscinodiscus lacustris* – centric diatoms and *Fragillaria construens, Navicula lacustris*, *Nitzschia gracillis, Nitzschia closterium* – pennate diatoms.

The predominance of diatoms in the plankton as number of species and populations density for each dominant species indicates the level trophicity that is quite low in 15 years of existence.

The plankton of damn lakes is a particular type because upstream it has a massive participation of rheophilic elements, and downstream being typical limnoplankton (CĂRĂUŞ, 1973).

46 taxa of diatoms were identified, which 9 represent centric diatoms, the others being pennat (Tab. 1).

Tab. 1 – The list of the diatoms taxa from the plankton of the Izvoru Muntelui – Bicaz Lake (2005)

Nr	**Taxa**
1.	*Achnanthes minutissima*
2.	*Achnantes lanceolata*
3.	*Achnanthes sp.*
4.	*Asterionella Formosa*
5.	*Caloneis amphisbaena*
6.	*Coconeis placentula*
7.	*Coconeis pediculus*
8.	*Coscinodiscus lacustris*
9.	*Cyclotella comta*
10.	*Cyclotella meneghiniana*
11.	*Cyclotella ocelata*
12.	*Cymatopleura eliptica*
13.	*Cymbella affinis*
14.	*Cymbella ventricosa*
15.	*Diatoma elongatum*
16.	*Diatoma hiemale*
17.	*Diatoma vulgare*
18.	*Didymosphenia geminate*
19.	*Fragilaria capucina*
20.	*Fragilaria construens*
21.	*Fragilaria crotonensis*
22.	*Fragilaria intermedia*
23.	*Gomphonema constrictum*
24.	*Gomphonema olivaceum*
25.	*Gyrosigma acuminatum*
26.	*Melosira italica*
27.	*Melosira roseana*
28.	*Melosira granullata*
29.	*Naviculla cuspidate*
30.	*Navicula gracilis*
31.	*Naviculla cryptocephala*
32.	*Naviculla hungarica*
33.	*Naviculla lacustris*
34.	*Nitzschia acicularis*
35.	*Nitzschia closterium*
36.	*Nitzschia gracilis*
37.	*Nitzschia linearis*
38.	*Nitzschia sigmoidea*
39.	*Pinullaria sp.*
40.	*Stephanodiscus astraea*
41.	*Stephanodiscus dubius*
42.	*Surirella ovata*
43.	*Synedra acus*
44.	*Synedra capitata*
45.	*Synedra ulna*
46.	*Synedra sp.*

The observations made in 2005 revealed specific behaviors of some populations of diatoms related with the depth in those three profiles established: surface, half of the photic zone and the limit of the photic zone presented forward.

In Baraj section the density of the planktonic diatoms was maximum of 385 000 individuals per litre in March (Tab. 3) in the surface profile and minimum in June at the profile of the inferior limit of photic zone. The diatoms high densities in the months with low temperature (less then 12°C – Tab. 3) can be explained by the fact that the diatoms are cryophilic stenotherm. The species with the highest densities were *Asterionella formosa* and *Fragillaria crotonensis*, that are associated frequently and prefer gulfs with high transparency and depth (90 m approximately Tab. 2), that favorises the development of its populations.

Tab. 2 – Abiotic parameters registered in Baraj section (2005)

Baraj section	Mar.05	Apr.05	May.05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	11,00	11,00	14,00	20,00	22,00	20,00	14,00	8,00	5,00
pH	7,50	7,60	7,50	7,50	7,50	7,50	7,50	8,00	8,50
Transparency (cm)	100,00	95,00	90,00	150,00	100,00	100,00	80,00	100,00	200,00

Tab. 3 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Baraj section (2005)

PROFILE	Mar.05	Apr.05	May05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	385.000	247.500	85.000	22.500	167.500	102.500	132.500	30.000	62.500
Half of the photic zone	175.000	282.500	57.500	17.500	95.000	42.500	230.000	175.000	205.000
Inferior limit of the photic zone	287.500	112.500	97.500	5.000	45.000	62.500	175.000	52.500	45.000

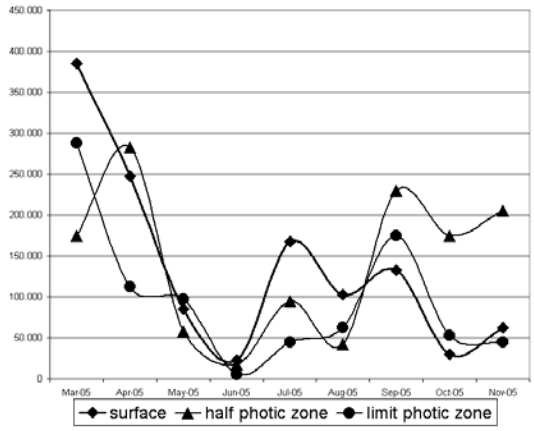

Fig. 2 -The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Baraj section (2005)

In Potoci Gulf section (Tab. 5) the density of diatoms from the plankton was 1 150 000 individuals per liter in cold months. The high densities of *Asterionella formosa* is explained by the fact that it is a stenothermic cryophilic species. In June *Stephanodiscus astraea,* that prefers wormer waters had as increased density 680 000 individuals per litre.

The species with the highest densities were *Asterionella formosa*, followed by *Stephanodiscus astraea* and *Nitzschia acicularis,* that are species with similar preferences for the nutrients quantity due to the presence of the fish farms.

Tab. 4 - Abiotic parameters registered in Potoci Gulf section (2005)

Potoci Gulf section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	11,00	12,00	16,00	22,00	23,00	21,00	16,00	10,00	6,00
pH	7,50	7,50	7,50	7,50	7,50	7,50	7,80	7,50	8,30
Transparency (cm)	80,00	90,00	170,00	100,00	100,00	100,00	60,00	200,00	100,00

Tab. 5 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Potoci Gulf section (2005)

PROFILE	Mar.05	Apr.05	May05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	720.000	765.000	310.000	722.500	357.500	115.000	105.000	47.500	47.500
Half of the photic zone	1.095.000	1.105.000	342.500	272.500	60.000	42.500	152.500	45.000	27.500
Inferior limit of the photic zone	1.055.000	230.000	82.500	115.000	7.500	27.500	65.000	57.500	45.000

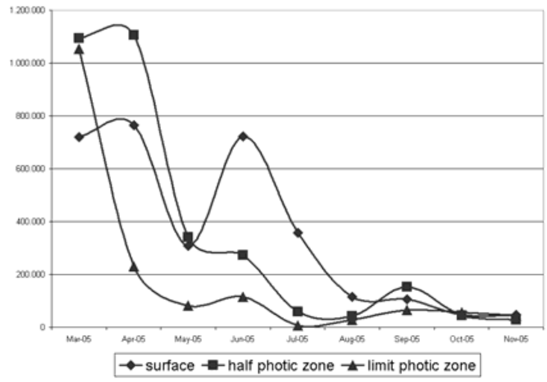

Fig. 3 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Potoci Gulf section (2005)

In Ruginesti Gulf section the density of diatoms from the plankton was maximum of 567 500 individuals per litre in July (Tab. 7), the other period of time the densities being quit low, comparing to the other sections (Fig. 5). The biovolume of the diatoms had the same maximum value, as the density also. The species with the highest percent of density and biomass were *Cyclotella comta* and *Diatoma elongatum*, that prefer increased temperature of water. The absence of the typical planktonic species for Izvoru Muntelui – Bicaz Lake, *Asterionella formosa,* was surprising, also the very small density of the species from the gena *Fragillaria,* due to some physical and chemical factors, probably.

Using more efficiently the phosphorus, *Asterionella* induces the decline of the development rate of *Cyclotella* that is favorised by much more lower concentrations of siliceous. At certain levels of the concentration both species are favourised, that leads to their coexistence. In conclusion, the intraspecific competition at the diatoms is due to „the law of minimum”.

Tab. 6 - Abiotic parameters registered in Rugineşti Gulf section (2005)

Rugineşti Gulf section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	10,00	8,00	15,00	20,00	20,00	22,00	16,00	12,00	6,00
pH	7,20	7,40	7,00	7,50	8,00	7,50	7,80	7,00	7,40
Transparency (cm)	70,00	80,00	100,00	100,00	80,00	80,00	30,00	80,00	110,00

Tab. 7 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Rugineşti Gulf section (2005)

PROFILE	Mar.05	Apr.05	May05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	270.000	65.000	97.500	415.000	567.500	95.000	65.000	127.500	30.000
Half of the photic zone	57.500	55.000	17.500	50.000	102.500	112.500	182.500	92.500	100.000
Inferior limit of the photic zone	7.500	40.000	27.500	32.500	190.000	40.000	65.000	72.500	50.000

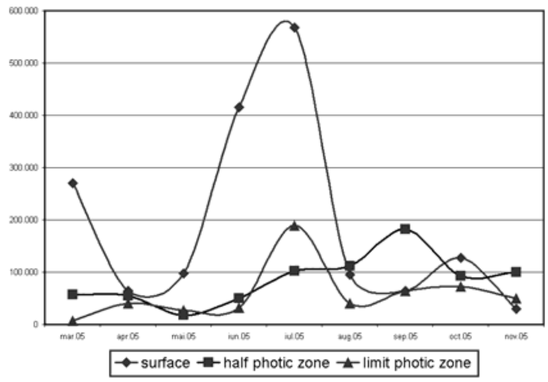

Fig. 4 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Rugineşti Gulf section (2005)

In Buhalniţa Gulf section the density of diatoms from the plankton was maximum at 315 000 individuals per litre in June (Tab. 9) at the surface horizon the higher percent being of *Cyclotella comta*, that had in June the biggest biovolume also. The Buhalnita section has a quit reduced depth of 20 – 30 m and it is influenced by winds that encrease the turbidity permanently leading to the limitation of photic zone that is maximum in June and July (Tab. 9). This way the species of centric diatoms are favorised and only *Fragillaria crotonensis* of pennate has a more obvious similarity coefficient, its presence being caused by the transportation of the main current of the lake from the maxim width of the zone - between Hangu and Buhalniţa. The others diatom species had low densities in the three sampling profiles (Fig.5).

Tab. 8 - Abiotic parameters registered in Buhalniţa Gulf section (2005)

Buhalnița Gulf section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	9,00	10,00	16,00	20,00	20,00	22,00	18,00	11,00	8,00
pH	7,00	7,30	7,00	7,50	7,50	7,50	7,80	7,00	7,90
Transparency (cm)	40,00	50,00	80,00	100,00	90,00	70,00	30,00	80,00	70,00

Tab. 9 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Buhalnița Gulf section (2005)

PROFILE	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	55.000	140.000	82.500	312.500	315.000	97.500	72.500	12.500	52.500
Half of the photic zone	92.500	57.500	17.500	57.500	55.000	15.000	17.500	60.000	65.000
Inferior limit of the photic zone	17.500	50.000	30.000	27.500	17.500	5.000	102.500	42.500	75.000

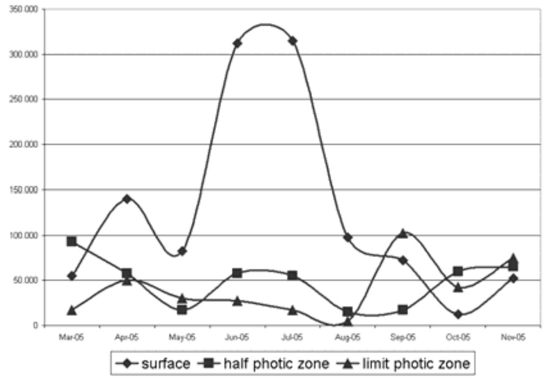

Fig. 5 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Buhalnița Gulf section (2005)

In Hangu Gulf section the density of diatoms from the plankton was maximum at 472 000 individuals per litre in June (Tab.11), (at 22ºC temperature) dominated by *Cyclotella comta*, that had a high percent of biovolume.

The influence of the intinsura zone can be observed in this section also (the presence of *Fragillaria crotonensis*), the small depth influenced the phenomenon of upwelling.

It is necessary to mention the presence of *Didimosphaenia geminata* in the plankton, invasive species in Romanian algae. This species that can be found accidentaly in this section is characteristic for the north of Europe. It is a tipical benthic species, forming gelly strata in the source area of mountain rivers and eliminates from the benthic biocenosis other diatom species. The presence of this species proves that the algal plankton can be populated by strictly benthic species. It must be mentionated that the high values of 8 of the pH from June and July (Tab.10) favorises the development of the benthic diatoms.

Tab. 10 - Abiotic parameters registered in Hangu Gulf section (2005)

Hangu Gulf section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	9,00	10,00	15,00	22,00	22,00	21,00	7,80	10,00	7,00
pH	7,50	7,50	7,50	8,00	8,00	7,00	7,40	7,00	8,10
Transparency (cm)	65,00	50,00	80,00	80,00	80,00	60,00	70,00	100,00	100,00

Tab. 11 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Hangu Gulf section (2005)

PROFILE	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	267.500	102.500	230.000	472.500	57.500	247.500	70.000	67.500	37.500
Half of the photic zone	52.500	97.500	75.000	67.500	57.500	227.500	87.500	17.500	100.000
Inferior limit of the photic zone	35.000	95.000	97.500	97.500	12.500	227.500	100.000	37.500	25.000

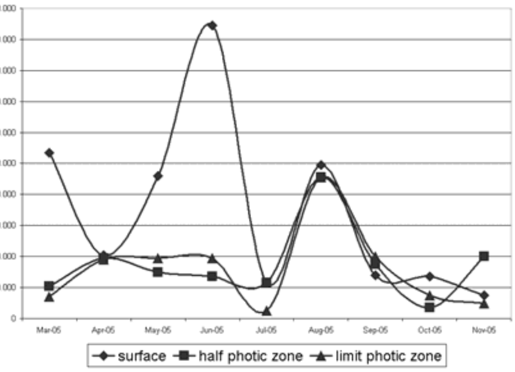

Fig. 6 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Hangu Gulf section (2005)

In Lake entrance section there is a quite unusual situation due to the domination of planktonic species *Asterionella formosa* and *Fragillaria crotonensis*. It can be observed the low density of the benthic diatoms transported by Bistriţa River. *Asterionella formosa* has a high density (1650000 individuals/litre). The high values of the density and biovolume from March and April are due to the photic zone that is reduced a lot, the entire diatoms population being concentrated to the surface horizon. We were not able to establish diatoms associations because of the specific conditions to this section – the influence of Bistriţa River, high and frequent variations of the water level and the turbidity (Tab.12).

Tab. 12 - Abiotic parameters registered in Lake entrance section (2005)

Lake entrance section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	8,00	9,00	14,00	23,00	21,00	22,00	14,00	9,00	7,00
pH	7,30	7,40	7,50	7,50	7,50	7,50	7,40	7,50	8,00
Transparency (cm)	15,00	20,00	50,00	70,00	60,00	50,00	50,00	40,00	20,00

Tab. 13 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Lake entrace section (2005)

PROFILE	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	920.000	360.000	62.500	152.500	110.000	45.000	145.000	182.500	42.500
Half of the photic zone	1.642.500	660.000	55.000	42.500	30.000	25.000	115.000	40.000	52.500
Inferior limit of the photic zone	910.000	247.500	67.500	32.500	35.000	10.000	25.000	97.500	132.500

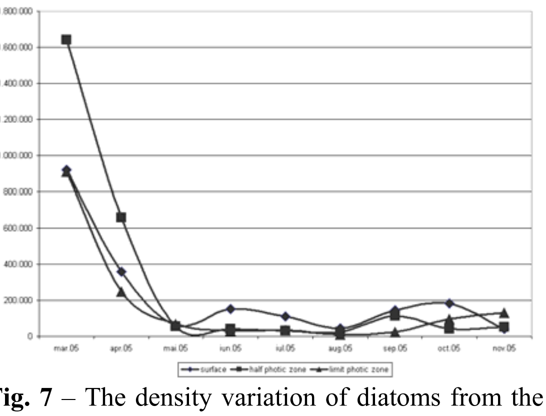

Fig. 7 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Lake entrace section (2005)

In Izvorul Alb Gulf section it can be observed quit high densities in March and April (Tab. 15) and the slow decrease starting from June, due to the increase of the temperature, *Asterionella formosa* having the highest density (maximum of 807 000 individuals per litre). The biomasa is at maxim in March being accomplished by *Asterionella formosa* and *Fragillaria crotonensis*. Even this section is placed in parallel with Rugineşti section and Buhalniţa section, the taxonomic composition is different due to its location, being protected against the main current of the like that this way cannot influence this section.

Tab. 14 - Abiotic parameters registered in Izvorul Alb Gulf section (2005)

Izvorul Alb Gulf section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	10,30	12,00	16,00	23,00	23,00	22,00	16,00	10,00	6,00
pH	7,50	7,00	7,50	7,50	7,50	7,50	7,50	7,50	8,10
Transparency (cm)	80,00	70,00	80,00	100,00	65,00	90,00	50,00	150,00	40,00

Tab. 15 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Izvorul Alb Gulf section (2005)

PROFILE	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	995.000	985.000	312.500	240.000	40.000	77.500	167.500	32.500	20.000
Half of the photic zone	1.100.000	717.500	477.500	195.000	30.000	52.500	27.500	117.500	17.500
Inferior limit of the photic zone	1.157.500	280.000	252.500	87.500	115.000	95.000	37.500	35.000	32.500

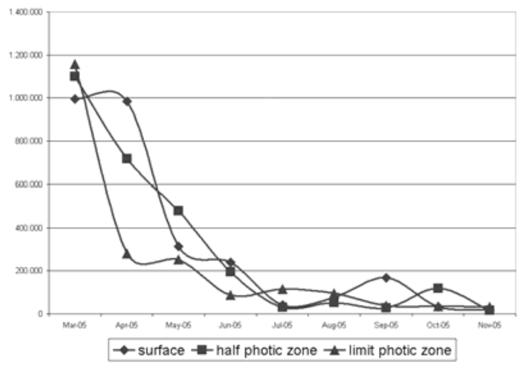

Fig. 8 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Izvorul Alb Gulf section (2005)

Like Izvorul Alb Gulf section, Secu Gulf section is not influenced by the main current of the lake, these two section presenting distinct features comparative to the other sections of the lake. In July the species of the genus *Cylotella* were dominant, because these species prefer a higher temperature (maximum of 25°C), (Tab. 16). In this section it can be observed a high density of facultative planktonic species like *Cyclotella comta* with 235 000 individuals per litre and *Coscinodiscus lacustris* – 152 000 individuals per litre).

Tab. 16 - Abiotic parameters registered in Secu Gulf section (2005)

Gulf Secu section	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Temperature °C	9,00	11,00	16,00	25,00	25,00	21,00	15,00	9,00	5,00
pH	7,40	7,40	7,50	7,50	7,50	7,50	7,80	7,50	8,10
Transparency (cm)	90,00	75,00	100,00	100,00	75,00	80,00	60,00	95,00	30,00

Tab. 17 - The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Secu Gulf section (2005)

PROFILE	Mar.05	Apr.05	May 05	Jun.05	Jul.05	Aug.05	Sep.05	Oct.05	Nov.05
Surface	415.000	180.000	107.500	27.500	387.500	152.500	60.000	37.500	37.500
Half of the photic zone	252.500	80.000	310.000	35.000	310.000	87.500	95.000	15.000	22.500
Inferior limit of the photic zone	232.500	57.500	42.500	32.500	137.500	47.500	77.500	22.500	37.500

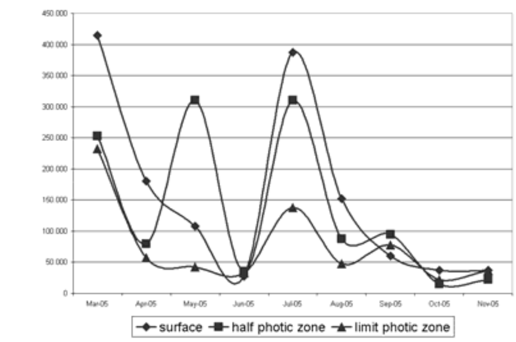

Fig. 9 – The density variation of diatoms from the plankton of Izvoru Muntelui – Bicaz Lake – Secu Gulf section (2005)

We can say as a conclusion that the main factor that determines this distribution of diatoms is the balance between the ecological requirements of the species for light and temperature and their vertical variation at the level of the three horizons established. To establish the characteristics of the distribution of the planktonic diatoms in the longitudinal profile of Izvoru Muntelui – Bicaz Lake were considered the data of analysis from the eight representative sampling sections placed along the lake. The research made during the years 2005 showed that each has distinct different characteristics concerning the algal biocenosis, that prouves that each is influenced by physical and geographycal factors that allow the individualisation of many ecological areas with different characteristics (Fig. 10).

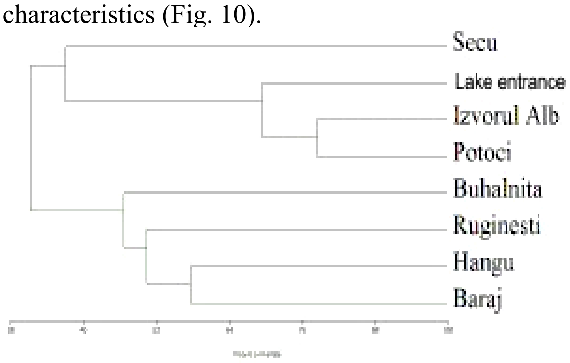

Fig. 10 - Graphic representation of the similarity coefficient of the sampling sections from the Izvoru Muntelui – Bicaz Lake

Conclusions

The density of the diatoms from the plankton is influenced by the abiotic features of the sampling section.

The density of the diatoms has a monthly variation, it wasn't registered a generalized maximum value for the entire lake Izvoru Muntelui – Bicaz.

In two sections - Baraj and Izvorul Alb- the diatoms density has maximum values in cold months (when the dominant species is *Asterionella formosa* Hass.), the densities of the other diatom species have maximum values in summer months when the dominant genus is *Cyclotella*.

Asterionella formosa – characteristic species for the Izvoru Muntelui – Bicaz Lake untill it's bigining, is maintained in important quantity today, being registered with segnificant quantitative values for the entire lake.

The sampling stations have distingtive features by means the algal biocenosis that proves that each section is influenced by phisical and geographical factors, that allowes to individualize some ecological zones with distingtive features.

Rezumat

Cercetările întreprinse pe parcursul anului 2005 în apa lacului de acumulare Izvoru Muntelui – Bicaz au permis stabilirea a 8 stații de prelevare a probelor fitoplanctonice, stații reprezentative pentru lacul Izvoru Muntelui – Bicaz, localizate astfel: secțiunea Baraj ; Golf Potoci, Golf Rugineşti, Golf Buhalnița, Golf Hangu, secțiunea Coadă Lac, Golf Izvorul Alb, Golf Secu.

Au fost prelevate un număr de 216 probe din cele 8 stații, cu frecvență lunară (suprafață, mijloc şi limită zonă fotică) utilizând batometrul. Din fiecare profil a fost prelevat un volum de 2 litri probă care a fost conservat, iar concentrarea probei s-a realizat prin sedimentare în laborator. Pentru înlăturarea supernatantului s-a utilizat trompa de vid. Proba concentrată a fost mineralizată în scopul înlăturării conținutului celular.

Analiza cantitativă s-a realizat cu ajutorul camerei de numărare Bürker-Türk, iar determinările calitative pe preparate lamă/lamelă. S-au efectuat 10 citiri/probă pentru evitarea erorilor.

Distribuția densității a evidențiat preferința unor specii pentru anumite orizonturi (suprafață, mijloc zonă fotică, limită zonă fotică) în funcție de factorii abiotici luați în studiu, precum şi afinitatea pentru fiecare secțiune de prelevare. Astfel, secțiunile de prelevare prezintă caractere distincte din punct de vedere a biocenozei algale, ceea cee arată că fiecare secțiune este influențată de factori fizico-geografici care permit individualizarea mai multor zone ecologice cu caractere distincte.

References

1. BURIAN P.V., 2002 - *Lacul de acumulare. Supraveghere biologică.* Ed. University Press, Tg. Mureş.
2. CĂRĂUŞU I., 1969 - Fitoplanctonul lacului de acumulare Bicaz (II). *Lucrările Stațiunii de Cercetări biologice, geologice şi geografice "Stejarul"*, II: 151-162.
3. CĂRĂUŞ I., 1979 - The quantitative dynamics of the phytoplancton of Bicaz water power reservoir (Romania): 1966-1978. *Lucrările Stațiunii de Cercetări biologice, geologice şi geografice "Stejarul"*: 97-110.
4. CĂRĂUŞ I., 1983 - Aspecte ale distribuției în timp şi spațiu a fitoplanctonului din Lacul de acumulare Izvorul Muntelui – Bicaz. *Monografie limnologică.* Ed. Academiei R.S.R, Bucureşti: 117-123.
5. MIRON I. and all., 1983 - *Lacul de acumulare Izvorul Muntelui – Bicaz. Monografie limnologică.* – Ed. Academiei R.S.R, Bucureşti: 224.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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MYCOCENOLOGICAL RESEARCH INTO *HIERACIO TRANSSILVANICO - PICEETUM* PAWL. ET BR.-BL. ASSOCIATION IN NEMIRA MOUNTAINS

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ABSTRACT

JIGĂU O., 2006 – Mycocenological research into *Hieracio transsilvanico-Piceetum* Pawl. et Br.-Bl. association in Nemira mountains. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 35-41.

Mycocoenological researches in *Symphyto cordati – Fagetum* association , to the identification of 173 of macroscopic fungi species among which 120 species belong to terricole synusium and 53 species belong to epixyle synusium.
The ecological spectrum is dominated by mycorhiyes species133, followed by saprophyte species 40.
The bioformes spectrum is dominated by mycetogeophytes (74,57 %).

Key words: Nemira Mountains, mycocenological associations, ecological spectrum, biological forms, and seasonal structure.

Introduction

Nemira Mountains are part of the central group of the Oriental Carpathians (Trotuş Mountains), making its southern border; they belong to the area of the eastern sedimentary mountains.

The main ridge stretches from the North to the South.

The limits of these mountains are situated between 26º 15 and 26º 30 Eastern longitude and 46º 03 and 46º 20 Northern latitude, spreading on a 700 Km area in the counties of Bacău, Covasna and Harghita, the middle third of the main ridge representing their separation line.

Hieracio transsilvanico-Piceetum Pawl. et Br.-Bl. (syn.: *Piceetum carpaticum* Soó 1930*, Piceetum montanum* auct. roman.) association is represented by spruce fir forests densely spread on all slopes of the superior mountain level in Romania's Carpathians, constituting a spruce fir underzone in the forest area. They live on acid brown soils, base-saturated, rich in modern humus, having either a very acid or a moderate acid reaction. At the inferior limit of the spruce fir areas, various nemoral species proliferate, as they are specific to beech forests.

Tab. 1 - The epixile and soil-living sinousia of macromycetes in the *Hieracio transsilvanico-Piceetum* association

Ecological category	Biological form	Aspect	v	pe	e	pa	a	K	val ec.
		Number of surveys	12	20	24	22	14		
		Area of survey mp	500	500	500	500	500		
MycEpx	Spl	Abortiporus biennis (Bull.) Singer				1		I	Nec
MycEpx	Spl	Anisomyces odoratus Fr. : Wulf			1	+	1	II	Nec
MycEpx	Spl	Armillaria mellea (Vahl) P. Kumm.			+	+		I	Co
MycEpx	Spl	Bjerkandera adusta (Willd. : Fr.) P. Karst.		+	+	+	2	I	Nec
MycEpx	Sl	Calocera viscosa (Pers. : Fr.) Fr.			1	+		I	Nec
MycEpx	Sl	Chlorociboria aeruginascens (Nyl.) Kanouse ex C.S. Ramamurthi, Korf & L.R. Batra			+	1		II	Nec
MycEpx	Sl	Crucibulum vulgare Tul.			2	1		III	Nec
MycEpx	Spl	Fomitopsis pinicola (Sow. : Fr.) Karst			1 +	+		II	Nec
MycEpx	Spl	Ganoderma applanatum (Pers.) Pat.				1	1	II	Nec
MycEpx	Spl	Ganoderma lucidum (Leyss : Fr.) Karst.			1	1	1	III	Nec
MycEpx	Spl	Gloeophyllum abietinum (Bull.: Fr.) Karst.		+	+	1	1	I	Nec

[*] "Ion Borcea" Natural Sciences Museum Complex

MycEpx	Sl	Gloeophyllum sepiarium (Wulf. : Fr.) P. Karst.			+	+	+	I	Nec
MycEpx	Sl	Heterobasidion annosum (Fr.) Bref.				1	+	II	Nec
MycEpx	Sl	Hirschioporus abietinus (Dicks.: Fr.) Donk			+			I	Nec
MycEpx	Sl	Hypholoma capnoides (Fr. : Fr.) Kumm.			+	+		II	Nec
MycEpx	Sl	Hypholoma fasciculare (Huds. : Fr.) Kumm.			+			II	Nec
MycEpx	Sl	Lycoperdon pyriforme Sch. : Pers.				1	1	III	Nec
MycEpx	Sl	Marasmiellus ramealis (Bull.: Fr.) Sing.			+			I	Nec
MycEpx	Sl	Mycena galericulata (Scop. : Fr.) S.F. Gray			1	+	+	III	Nec
MycEpx	Sl	Mycena polygramma (Bull. : Fr.) S.F. Gray			+			II	Nec
MycEpx	Sl	Mycena viscosa (Secr.) Maire			1	+		II	Nec
MycEpx	Sl	Pholiota alnicola (Fr. : Fr.) Sing.			1		+	III	Nec
MycEpa	Spl	Pholiota destruens (Brond.) Gill.			1		+	II	Nec
MycEpx	Sl	Pholiota spumosa (Bolt. : Fr.) Sing			+	1		II	Nec
MycEpx	Sl	Pholiota squarrosa (Weigel. : Fr.) Kumm.			1	1	1	II	Nec
MycEpx	Sl	Pluteus cervinus (Sch.) Kumm.			+	+		III	Nec
MycEpx	Sl	Postia caesia (Schrad.) P. Karst.			1			I	Nec
MycEpx	Sl	Pseudohydnum gelatinosus (Scop. : Fr.) P. Karst			+	1		I	Nec
MycEpx	Sl	Ramaria apiculata (Fr.) Donk				1	1	II	Nec
MycEpx	St	Ramaria stricta (Pers. : Fr.) Quél.				+	+	I	Nec
MycEpx	Sl	Sarcoscypha coccinea (Fr.) Lamb.		+				I	Nec
MycEpx	Sl	Scutellinia scutellata (L. : Fr.) Lamb.	+			1		I	Nec
MycEpx	Sl	Spongipellis borealis (Fr. : Fr.) Pat.			1		+	II	Nec
MycEpx	Sl	Stereum hirsutum (Willd : Fr.) S.F. Gray	+	1	2	+	1	II	Nec
MycEpx	Sl	Stereum purpureum (Pers.) Fr.				+		I	Nec
MycEpx	Spl	Trametes abietina (Dick.) Pil.			+	1	1	II	Nec
MycEpx	Sl	Tricholomopsis rutilans (Sch. : Fr.)Sing			1		+	I	Nec
MycEpx	Sl	Ustulina deusta (Fr.) Petrak.		2	3		1	II	Nec
MycEpx	Sl	Xylaria hypoxylon (L. : Fr.) Grev.		1			1	I	Nec
MycG	St	Agaricus silvaticus Sch. : Fr.			1	+		II	Coo
MycG	St	Agaricus silvicola (Vitt) Sacc.			1	+		II	Coo
MycG	Mr	Albatrellus confluens (Alb. & Schwein.) Kotl. & Pouzar			+	1		I	Nec
MycG	Mr	Albatrellus cristatus (Schaeff.) Kotl. & Pouzar Schff.)				+	+	I	Nec
MycG	Mr	Albatrellus ovinus (Schaeff.) Kotl. & Pouzar			+	+		I	Nec
MycG	Mr	Amanita aspera (Fr.) Hooker			+	+		II	Co
MycG	Mr	Amanita citrina (Sch.) Pers.			2	+		II	Tox
MycG	Mr	Amanita innaurata Secr.			+	+		II	Nec
MycG	Mr	Amanita muscaria (L. : Fr.) Hook.			2	2	+	II	Tox
MycG	Mr	Amanita pantherina (D.C. : Fr.) Krombch.			1	2		II	Tox
MycG	Mr	Amanita phalloides (Fr.) Link			1	2	+	III	Tox
MycG	Mr	Amanita porphyria (A. et. S. : Fr.) Secr.				+	+	II	Tox
MycG	Mr	Amanita rubescens Pers. : Fr.			+	3		III	Co
MycG	Mr	Amanita spissa (Fr.) Kumm.			+	+		II	Co
MycG	Mr	Amanita vaginata (Bull. : Fr.) Vitt.			+	+		III	Tox
MycG	St	Astraeus hygrometricus (Pers. : Pers.) Morgan				+		II	Nec
MycG	Mr	Boletus badius (L.: Fr.)Quél.				1	1	II	Co
MycG	Mr	Boletus calopus Pers. : Fr.				+		II	Nec
MycG	Mr	Boletus chrysenteron Bull.				+	+	II	Co
MycG	Mr	Boletus edulis (Bull.) Fr.				2	2	II	Coo
MycG	Mr	Boletus erythropus (Fr.) Kbch.			1	2	+	II	Coo
MycG	Mr	Boletus luridus Sch. : Fr.				1	1	I	Co
MycG	Mr	Boletus subtomentosus (Scop.: Fr.) Berk.			+	+		II	Co
MycG	Mr	Cantharellus cibarius (Fr. : Fr.) Fr.			2	4		II	Coo
MycG	Mr	Cantharellus lutescens (Pers. : Fr.) Fr.				+		I	Nec
MycG	Mr	Cantharellus tubaeformis (Bull. : Fr.) Fr.			1	+		II	Nec
MycG	Mr	Chroogomphus rutilus (Schff.: Fr.) Miller				+	+	I	Nec
MycG	St	Ciboria batschiana (Zopf.) Buchw.			2	+	1	I	Nec
MycG	St	Clavulina amethytina (Fr.) Donk.			+	+		II	Nec
MycG	St	Clavulina cristata (Holmsh. : Fr.) Schroet.			2		1	II	Nec
MycG	St	Clavulina rugosa (Bull. : Fr.) Schroet.			+			I	Nec
MycG	St	Clitocybe brumalis (Fr. : Fr.) Kumm.				+	+	I	Nec
MycG	St	Clitocybe cerussata (Fr.) Kumm				1		II	Tox
MycG	St	Clitocybe dealbata (Sow. : Fr.) Kumm.				+	+	II	Tox
MycG	St	Clitocybe gibba (Pers. : Fr.) Kumm.		+	1	1		II	Co
MycG	St	Clitocybe odora (Bull. : Fr.) Kumm.			1	+		II	Nec
MycG	St	Collybia confluens (Pers. : Fr.) Kumm						II	Nec
MycG	St	Collybia tuberosa (Bull. : Fr.) Kumm.			+	+		II	Nec
MycG	St	Coltricia perrennis (L. :Fr.) Murr			2	+		II	Nec
MycG	St	Coprinus disseminatus (Pers. : Fr.) S.F. Gray			1	1		III	Nec
MycG	St	Coprinus plicatilis (Curt. : Fr.) Fr.			+	1	1	II	Nec
MycG	Mr	Cortinarius armeniacus (Sch. : Fr.) Fr.			+	+		III	Co
MycG	Mr	Cortinarius bovinus (Pers.: Fr.) Fr.			2	1	1	II	Nec
MycG	Mr	Cortinarius collinitus (Sow : Fr.) Fr.			+	1		I	Co
MycG	Mr	Cortinarius torvus (Fr. : Fr.) Fr.			1			I	Nec

MycG	Mr	Cortinarius variecolor (Pers.) Fr.			1	1	+	I	Co
MycG	Mr	Cortinarius venetus (Fr.) Fr.			+	1	+	II	Nec
MycG	Mr	Gomphidius glutinosus (Sch. : Fr.) Fr.			+	+		II	Co
MycG	Mr	Gomphus clavatus (Pers.: Fr.)S.F. Gray				1	+	I	Co
MycG	St	Gyromitra esculenta (Pers.) Fr.	+		1	1		I	Coo
MycG	St	Gyromitra infula (Sch. : Fr.) Quél.	+		+			I	Co
MycG	St	Helvella crispa (Scop. : Fr.) Fr.			1	1	1	I	Co
MycG	St	Helvella macropus(Pers. : Fr.) P. Karst.			1	+		I	Nec
MycG	St	Helvella silvicola (Beck.: Sacc.)Harmaja		1				II	Nec
MycG	Mr	Hydnum repandum Fr. : Fr.			1	+		III	Co
MycG	Sp	Hygrocybe conica (Scop.: Fr.) Kumm.			+	+		I	Nec
MycG	Sp	Hygrocybe miniata (Fr.: Fr.) Kumm.			1	+		I	Nec
MycG	Mr	Hygrocybe spadicea (Scop.) P. Karst.			+	+		II	Nec
MycG	Mr	Hygrophorus eburneus (Bull.:Fr.) Fr.			+	1	1	I	Nec
MycG	Mr	Hygrophorus pustulatus (Pers. : Fr.) Fr.			1			II	Nec
MycG	Mr	Inocybe fastigiata (Sch. : Fr.) Quél.			1	+		II	Nec
MycG	Mr	Inocybe geophylla (Bull. : Fr.) Karst.			+	+		II	Nec
MycG	Mr	Inocybe geophylla var. violacea Pat.			1	+		II	Nec
MycG	Mr	Inocybe lacera (Fr.: Fr.) Kumm.			1	1		I	Nec
MycG	St	Laccaria amethystina (Bolt. : Hook.) Murr.			+	2		II	Co
MycG	St	Laccaria laccata (Scop. : Fr.) Berk. et. Br.			+	1	+	II	Co
MycG	Mr	Lactarius deliciosus (L. : Fr.) S.F. Gray			2	3	2	III	Coo
MycG	Mr	Lactarius deterrimus Gröger			+	+		III	Nec
MycG	Mr	Lactarius mitissimus (Fr. : Fr.) Fr. ss. str. Blum.			+	+		II	Nec
MycG	Mr	Lactarius piperatus (Scop. : Fr.) S.F. Gray			2	2	1	III	Co
MycG	Mr	Lactarius pyrogalus (Bull. : Fr.) Fr.				+		II	Nec
MycG	Mr	Lactarius rufus (Scop. : Fr.) Fr.			1	+		II	Nec
MycG	Mr	Lactarius salmonicolor Heim. & Lecl.			+	1		II	Co
MycG	Mr	Lactarius scrobiculatus (Scop. : Fr.) Fr.			+	2		III	Tox
MycG	Mr	Lactarius subdulcis (Pers. : Fr.) S.F. Gray			1			II	Co
MycG	Mr	Lactarius vellereus (Fr. : Fr.) Fr.			1	3		I	Nec
MycG	Mr	Lactarius volemus (Fr. : Fr.) Fr.			1	1		II	Co
MycG	St	Leotia lubrica Pers. : S.F. Gray			1	+		I	Co
MycG	St	Lepiota clypeolaris (Bull.: Fr.) Kumm.			+	+		II	Nec
MycG	St	Lepiota cristata (Alb. et. Schm. : Fr.) Kumm.			1	+	1	II	Nec
MycG	Mr	Lepista nuda (Bull. : Fr.) Cooke				+	+	I	Nec
MycG	Sh	Lycoperdon echinatum Pers. : Pers.			1	1		II	Co
MycG	Sh	Lycoperdon perlatum Pers. : Pers.				2	2	II	Co
MycG	St	Macrolepiota procera (Scop. : Fr.) S.F. Gray			2	1		II	Co
MycG	St	Macrolepiota rhacodes (Vitt.) Sing.			1	2		III	Nec
MycG	Sf	Marasmius androsaceus (L.: Fr.) Fr.			+	+		I	Nec
MycG	Sf	Marasmius cohaerens (Pers. : Fr.) Cooke et. Quél.			+	+		II	Nec
MycG	St	Morchella conica Pers.	+	+				I	Coo
MycG	Sf	Mycena acicula (Schff.:Fr.) Kumm.						II	Nec
MycG	Sf	Mycena capillaris (Schum. : Fr.) Kumm.						II	Nec
MycG	Sr	Mycena pura (Pers.: Fr.) Kumm.			2	2		III	Nec
MycG	Sf	Mycena vulgaris (Pers. : Fr.) Kumm.			+	+		II	Nec
MycG	St	Oudemansiella longipes (Bull. : Kumm.) Moser			+			II	Nec
MycG	St	Oudemansiella radicata (Relh. : Fr.) Sing.			+	1		III	Nec
MycG	St	Peziza aurantia (Pers.) Fr.	+				1	I	Nec
MycG	St	Peziza badia Pers. : Fr.	+			2		I	Co
MycG	Mr	Phellodon niger (Fr. : Fr.) P. Karst.				+		I	Nec
MycG	St	Psilocybe coprophila (Bull. : Fr.) Kumm.			1	1		II	Nec
MycG	St	Psilocybe montana (Pers. : Fr.) Kumm.			+	1	+	II	Nec
MycG	Mr	Ramaria aurea (Sch.) Quél.			1	2	1	II	Nec
MycG	Mr	Ramaria botrytis (Pers. : Fr.) Ricken			3	2		II	Coo
MycG	Mr	Ramaria flava (Sch. : Fr.) Quél.				1		II	Co
MycG	Mr	Ramaria formosa (Pers. : Fr.) Quél.				2	2	I	Tox
MycG	Mr	Ramaria ocraceovirens (Jungh) Donk				2	1	I	Co
MycG	Mr	Rozites caperata (Pers. : Fr.) P. Karst.			+	+		II	Nec
MycG	Mr	Russula albonigra (Krombh.) Fr.			2	3		III	Nec
MycG	Mr	Russula aurata (With. : Fr.) Fr.			+	+		I	Nec
MycG	Mr	Russula chloroides (Krombh.) Bres.			2	2	2	II	Tox
MycG	Mr	Russula cyanoxantha (Sch.) Fr.			1	2		I	Nec
MycG	Mr	Russula delica Fr.			3	1		III	Coo
MycG	Mr	Russula emetica (Sch. : Fr.) Pers.			1	1		II	Tox
MycG	Mr	Russula foetens (Pers. : Fr.) Fr.			4	2	2	III	Nec
MycG	Mr	Russula fragilis (Pers. : Fr.) Fr.			2	2	1	II	Nec
MycG	Mr	Russula lepida (Fr. : Fr.) Fr.				+		II	Nec
MycG	Mr	Russula mustelina Fr.				+		II	Co
MycG	Mr	Russula nigricans Fr.			2	2	+	III	Nec
MycG	Mr	Russula quélétii Fr. in. Quél.				1	+	II	Tox
MycG	Mr	Russula violacea Quél.				1	+	I	Nec

MycG	Mr	Russula virescens (Schff.) Fr.			1	2	+	III	Coo
MycG	Mr	Russula xerampelina (Sch.) Fr.			+	+		II	Co
MycG	Mr	Sarcodon imbricatus (Fr.) Karst.				1	+	I	Nec
MycG	Mr	Strobilomyces strobilaceus (Scop. : Fr.) Berk.				1		I	Nec
MycG	Sf	Stropharia aeruginosa (Curt : Fr.) Quél.			2		2 +	II	Nec
MycG	St	Thelephora caryophyllea (Sch. : Fr.) Fr.			2		2	II	Nec
MycG	St	Thelephora palmata (Scop. : Fr.) Fr.				+	+	I	Nec
MycG	St	Thelephora terrestris Ehrenb. : Fr.			1		1	I	Nec
MycG	St	Tremiscus helvelloides (DC. : Pers.) Donk				+		II	Co
MycG	Mr	Tricholoma pardinum (Pers.) Quél.				+	+	I	Nec
MycG	Mr	Tricholoma saponaceum (Fr. : Fr.) Kumm.			+	1		II	Nec
MycG	Mr	Tricholoma sulphureum (Bull. : Fr.) Kumm.			1	2		II	Nec
MycG	Mr	Tricholoma terreum (Sch.) Kumm			+	+		I	Coo
MycG	Mr	Tricholoma virgatum (Fr. : Fr.) Kumm.			+	+		I	Tox
MycG	Mr	Volvariella bombycina (Pers.: Fr.) Sing.			+	+		I	Nec
		Specii însoțitoare:							
MycG	St	*Peziza badia* Pers. : Fr.	+			2		I	Nec
MycEpx	Sl	*Sarcoscypha coccinea* (Fr.) Lamb.		+				I	Nec
MycG	Sl	*Ciboria batschiana* (Zopf.) Buchw.			2	+	1	I	Nec
MycEpx	Sl	*Stereum purpureum* (Pers.) Fr.				+		I	Nec
MycG	St	*Clavulina rugosa* (Bull. : Fr.) Schroet.			+			I	Co
MycEpx	Sl	*Hirschioporus abietinus* (Dicks.: Fr.) Donk			+			I	Nec
MycEpx	Sl	*Tyromyces caesius* (Schrad.: Fr.) Murr.			1			I	Nec
MycEpx	Sl	*Marasmiellus ramealis* (Bull.: Fr.) Sing.			+			I	Nec
MycEpx	Sl	*Volvariella bombycina* (Pers.: Fr.) Sing.			+	+		I	Nec
MycG	Mr	*Russula cyanoxantha* (Sch.) Fr.			1	2		I	Co
MycG	Mr	*Lactarius vellereus* var. *vellereus* (Fr.) Fr.			1	3		I	Co

Place of the survey
1,2,3,13,14,15,16,17,33,34,35,36,57,58,59,60,61-Slănic Moldova
4,5,6,18,19,20,21,22,37,38,39,40,41,42,62,63,64,65,66,67-Poiana Sărată
7,8,9,23,24,25,26,27,43,44,45,46,47,48,68,69,70,71,72,86, 87,88- Izvorul Alb
10,11,12,28,29,30,31,32,49,50,51,52,53,54,55,56,57-Dofteana- Sărărie
DAY OF THE SURVEY
1,2,3(6.04.2000),4,5,6(2.05.2003), 7,8,9(20.05.2004),10,11,12(29.05.2003)
13,14,15,16,17(24.05.2003),18,19,20,21,22(5.06.1999), 23,24,25,26,27(14.06.1999),
28,29,30,31,32(24.06.1999),33,34,35,36(6.07.2000), 27,38,39,40,41,42(28.07.2000)
43, 44, 45(19.08.2003), 46, 47, 48(25.08.2003), 49, 50, 51, 52(28.08.2003), 53, 54, 55, 56(30.08.2003), 57, 58, 59 (30.09.2000), 60, 61(8.09.2004), 62, 63, 64, 65, 66, 67(11.09.2003), 68, 69, 70, 71, 72(17.09.2003), 73,7 4, 75(21.09.2003), 76, 77, 78(22.09.2004), 79, 80, 81(2.10.2000), 82, 83, 84, 85 (6.10.2003), 86, 87, 88(15.10.2003), 89, 90, 91, 92(20.10.2004).
Aspects of the surveys
1-12 vernal
13-32 preestival
33-56 estival
57-78 preautumnal
79-92 autumnal

Results and discussions

In the vernal and preestival aspect there have been found 9 species and 38 species respectively, it being represented especially by ascomycetes: *Morchella conica, Scutellania scutellata* (Fig. 2).

In the estival aspect there have been found 109 species, it being dominated by *Amanita rubescens*, *Oudemansilla radicata, Russula cyanoxantha, Lactarius piperatus*

In the epixile sinousia more abundant are the following species: *Stereum hirsutum, Bjerkandera adusta, Coriolus versicolor, Polypopus varius, Pluteus cervinus, Hypholoma fasciculare* etc. The estival aspect is represented by 129 species (70.9 %).

The preautumnal aspect is richer in species (125 species), of which more frequent are: *Mycena pura, Collybia peronata, Armillaria mellea, Cratherellus cornucopioide.*

In the autumnal aspect there have been identified 61 species of which 49 species (35.7 %) in the soil-living sinousia *Clavulina cinerea, Collybia peronata, Marasmius alliaceus, Cortinarius turbinatus, Russula cyanoxantha, Lactarius vellereus, Russula emetica, Cantharellus cibarius* and 12 species (14.8 %) in the epixile sinousia; *Coriolus versicolor, Armillaria mellea* are more frequent.

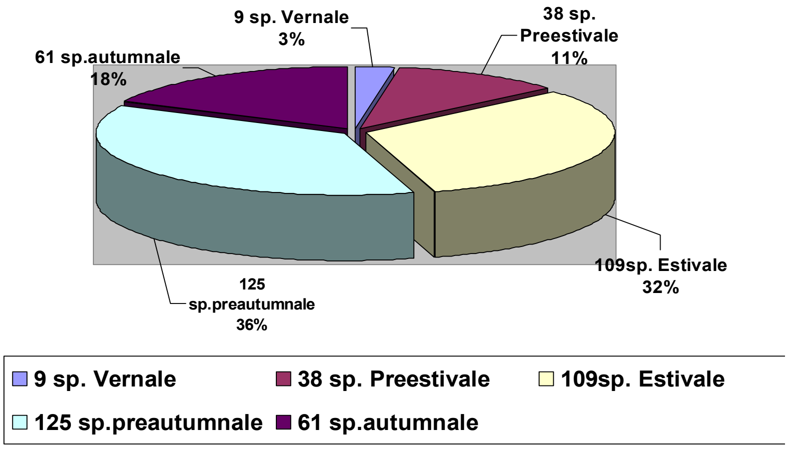

Fig. 2 - The seasonal structure of the macromycete species in the *Hieracio transsilvanico-Piceetum* association

The ecological spectrum, the biological forms of the macromycete species in the *Hieracio transsilvanico-Piceetum* association shows the following facts:

Categorii ecologice si forme biologice	Species nr.	%
	173	
Ecological spectrum		
Saprotrophic species:	84	
Saprotrophic species on humus (Sh)	2	1,12
Saprotrophic species on wood (Sl)	32	18,64
Saprotrophic species on leaft (Sf)	5	4,72
Saprotrophic species on land (St)	44	25,42
Saprotrophic species on pasture(Sp)	2	1,12
Saproparazite species on wood (Spl)	9	5,08
Mycorrhizal species (Mr)	68	45,19
Biological forms		
Micetogeofite (MycG)	130	74,57
Micetoterofite (MycTh)	3	1,69
Micetoepifite xiloze (MycEpx)	39	22,59
Micetoepifite arboricole (MycEpa)	1	0,56

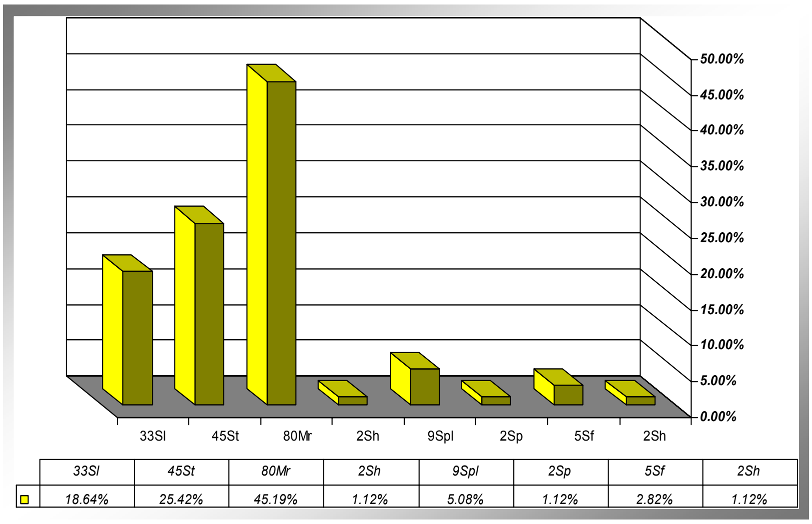

Fig. 3 - The ecological spectrum of the macromycete species in the *Hieracio transsilvanico-Piceetum* association

The ecological spectrum (Fig.3) is dominated by Saprophyte species (87 species) in a larger sense, of which the soil living (St) (25.42 %) and wood living (Sl) (18.64 %) species are most abundant. On the other hand, the micorrhizal macromycetes (Mr) 68 species (45.19 %) are well represented.

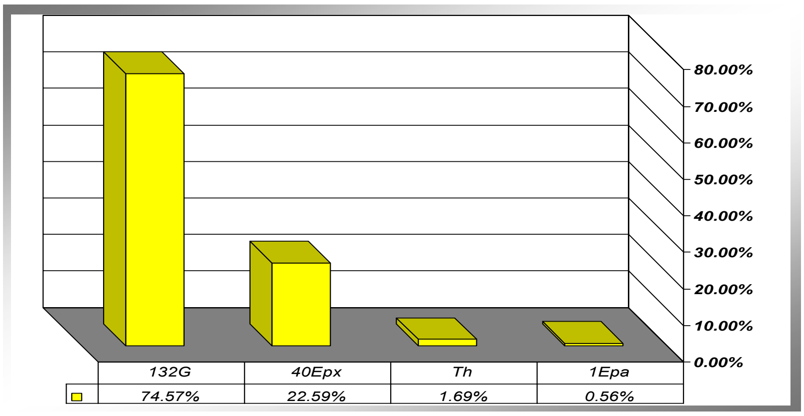

Fig. 4 - The biological forms of the macromycete species in the *Hieracio transsilvanico-Piceetum* association

The spectrum of the bioforms (Fig.4) is remarkable through its predominance of mycetogeophytes (MycG)(67.6 %) and xilose mycetoepiphytes (MycEpx) (23 %).

The economic value is given by 67 esculent species (Co) (38.06 %), of which 21.3 % are good, 9.9 % are very good, 6.8 % eatable, as the following: *Boletus edulis, Cantharellus cibarius, Agaricus silvicola, Lepista nuda, Russula cyanoxantha, Russula vesca, Pleurotus ostreatus*

The high number of some species also gives the economic value: *Russula cyanoxantha*, *Cantharellus cibarius, Boletus edulis.*

Toxic macromycetes form a group of 17 species (Tox) (9.3 %): *Amanita phaloides*, which has the highest degree of toxicity (Fig. 5).

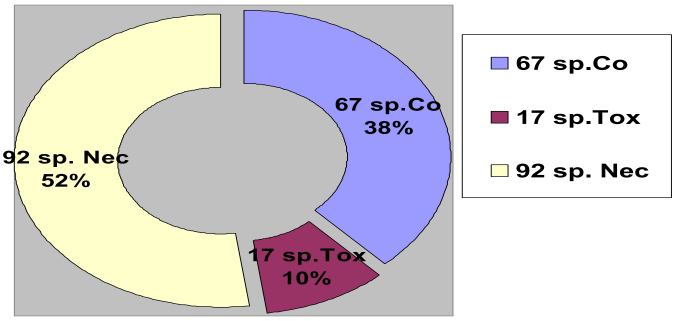

Fig. 5 - The economical value of macromycete species in the *Hieracio transsilvanico-Piceetum* association

Conclusion

After the mycocenological research in 2000 and during 2003-2005 in the *Hieracio transsilvanico-Piceetum* Pawl. et Br.-Bl. there have been identified 173 species of macromycetes, of which 120 species (69.49 %) belong to the soil-living sinousia and 53 species (30.50 %) belong to the epixile sinousia.

The ecological spectrum is dominated by Saprophyte species in a larger sense: 87 species, of which the soil living (St) (25.42 %) and wood living (Sl) (18.64 %) are the most numerous. The micorrhizant species (Mr) (45.19 %) are also well represented. Among bioforms, mycetogeophytes (MycG) (133 species, 74.57 %) and xilose mycetoepiphytes (MycEpx) (40 species, 22.59 %) are well represented too.

Analysing the constancy (K) of the species, we can say that one *Cyathus striatus* species has the IV constancy and 24 species (13.63 %) have the III constancy. Most of species have the II constancy (91 species, 51.70 %) and the I constancy (61 species, 34.65 %).

References

1. CHIFU T., MÂNZU C., ZAMFIRESCU O., 2006 - *Flora & vegetaţia Moldovei (România*). Iaşi, Edit. Univ Al. I. Cuza. Vol II.: 416-456, 511-512.
2. JIGĂU O., 2003 - *Biodiversitatea macromicetelor din Bazinul Sărăriei – Munţii Nemira*. Stud. Cercet. Biolog. Complex. Muz. Bistriţa – Năsăud 9: 75-85.
3. JIGĂU O., 2004 - *Diversitatea macromicetelor din Bazinul Izvorul Alb – Munţii Nemira.* Stud. Com. Complex. Muz. Şt. Nat. „Ion Borcea". Bacău. IX: 9- 13.
4. JIGĂU O., 2004 - *La diversite des macromycetes dans la Poiana Sărată-les Montangnes Nemira.* Stud. Com. Complex. Muz. Şt. Nat. Muzeul Olteniei Craiova XX : 48-52 .
5. JIGĂU O., 2005 - *Macromycetes diversity from the Dofteana basin- Nemira Mountains.* Stud. Cercet. Biolog. Complex Muz. Bistriţa – Năsăud 10: 21-26.
6. MITITELU D., BARABAŞ N., 1980 – 1993 - *Flora şi vegetaţia Munţilor Nemira.* Stud. Com., Complex. Muz. Şt. Nat. "Ion Borcea". Bacău: 29 – 48.
7. ŞESAN T. E., TĂNASE C., 2006 – *Mycobiota – Sisteme de clasificare*, Iaşi, Edit Univ Al. I. Cuza, 9-251.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 42 – 44

THE BIODIVERSITY OF THE MICROMYCETES IN THE DOFTEANA ARBORETUM, BACAU COUNTY

OTILIA CARMEN PAVEL*

Abstract

PAVEL C. O., 2005 - The biodiversity of the micromycetes in the Dofteana Arboretum, Bacau county. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol.21: n-m.

The autor presents a number of 46 micromycetes, living on 45 plants, in 60 fungi - host plants combinations which were gathered in 1998 - 2004 from Hemeiuş Arboretum. The species of micromycetes identified belong to: 2 kingdom, 3 phylums, 3 classes, 10 orders, 15 families, and 26 genera.

Key words: micromycetes, Dofteana, Bacău

Introduction

The Dofteana Arboretum was founded between 1905 – 1910 arranging a surface of 30 ha on the middle terrace of the Dofteana valley (in Bacău County). The flora epithome contains a number of 635 tree species and 237 herbaceous species and mosses.

The dendrological collections lies on a surface of 24 hectares, in the western part of the arboretum, on a surface of 10 hectares there lay an oak hornbeam forest.

The first mention belongs to C. Georgescu who gave a signal of the *Cercospora juniperina* Georg. et Bad. and *Gymnosporangium cornutum* Arthur ex F. Kern on *Juniperus communis* L. (4, 5). M. Petrescu and G. Negrean were mentioned on the *Melampsora laricis-populina* Kleb on *Populus canadensis* F.Michx. (7).

Material and method

The mycological material was collected while itinerary trips.

The examinations was effectuated at the Olympus SZ61 stereomicroscope and at the Olympus CX 31 microscope.

The determination of micromycetes species was done according to literature (1, 8, 9, 10, 11, 12).

The classification and the nomenclature of the species were updated according to Index Fungorum (14).

The mycological material was preserved and introduced in the collection of micromycetes of the Museum of Natural Sciences from Bacău.

Results and discussions

The identified micromycetes, in number of 46 are from the Chromista and the Fungi kingdom and they belong to 3 phylums (Oomycota, Ascomycota, Basidiomycota), 3 classes, 10 orders, 15 families, 26 genera. A taxonomically arranged list of all the species collected is reported in a list.

The micromycetes are put in the alphabetical order of families, genera and species.

Kingdom Chromista

Phylum Oomycota

Class Oomycetes
Subclass Incertae sedis
Order Peronosporales
Family Peronosporaceae

1. *Plasmopara viticola* (Berk. et Kurt.) Berl. Et de Toni1 on *Vitis vinifera* L, 15 VII 2002.
2. *Plasmopara nivea* (Unger) J. Schröt on *Aegopodium podagraria* L., 17 VII 2004.
3. *Bremia lactucae* Regel on *Arctium lappa* L., 17 VII 2002.

Kingdom Fungi

Phylum Ascomycota

Class Ascomycetes
Subclass Dothideomycetidae

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Order Dothideales
Family Incertae sedis

1. *Stigmina carpophila* (Lév.) M.B. Ellis f.c. *Clasterosporium carpophilum* (Lév.) Aderh. on *Prunus avium* L., 17 VII 2003.

2. *Stigmina juniperina* (Georgescu & Badea) M.B. Ellis
on *Juniperus communis* L., 7 VII 2003;
on *Juniperus communis* L. 'Hibernica', 7 VII 2003.

Order Mycosphaerellales
Family Mycosphaerellaceae

3. *Mycosphaerella microsora* Syd & P. Syd. f. c. *Cercospora microsora* Sacc.
on *Tilia cordata* Sacc., 18 VII 2001, 17 VII 2002;
on *Tilia plathyphillos* Scop., 18 VII 2001, 17 VII 2002.

4. *Mycosphaerella populi* (Auersw.) J. Schröt. f.c. *Septoria populi* Desm., on *Populus alba* L., 12 VIII 2004.

5. *Mycosphaerella podagrariae* (Fr.) Petr. f.c. *Septoria podagrariae* Lasch on *Aegopodium podagraria* L., 20 VIII 2004.

6. *Septoria convolvuli* Desm. on *Convolvulus arvensis* L., 12 VIII 2003.

7. *Septoria cornicola* Desm. on *Cornus sanguinea* L., 18 VII 2001.

Family Leptosphaeriaceae

8. *Coniothyrium concentricum* (Desm.) Sacc. on *Yucca filamentosa* L., 15 VII 2002.

Family Venturiaceae

9. *Venturia inaequalis* (Cooke) Aderh. on *Malus pumila* Mill., 15 VII 2002.

10. *Venturia pyrina* Aderh. on *Pyrus pyraster* L., 12 VIII 2003.

Subclass Incertae sedis
Order Incertae sedis
Family Incertae sedis

11. *Sphaeropsis sapinea* (Fr.) Dyko & B. Sutton on *Pinus sylvestris* L., 16 VII 2002.

Subclass Erysiphomycetidae
Order Erysiphales
Family Erysiphaceae

12. *Erysiphe cichoracearum* Jacz. on *Taraxacum officinale* Weber, 12 VIII 2003.

13. *Erysiphe convolvuli* DC. on C*onvolvulus arvensis* L., 12 VIII 2003.

14. *Erysiphe depressa* (Wallr.) Schltdl on *Arctium lappa* L., 2 VIII 2003.

15. *Erysiphe heraclei* DC.
on *Heracleum sphondylium* L., 15 VII 2002;
on *Peucedanum oreoselinum* (L.) Moench, 8 VI 2004.

16. *Erysiphe betae* (Vaňha) Weltzien on *Polygonum aviculare* L., 12 VIII 2003.

17. *Erysiphe sordida* Junell on *Plantago major* L., 12 VIII 2003.

18. *Erysiphe syringae* Schwein. on *Syringa vulgaris L.*, 12 VIII 2003.

19. *Golovinomyces cynoglossi* (Wallr.) V.P. Heluta on S*ymphythum officinale* L., 12 VIII 2003.

20. *Neoerysiphe galeopsidis* (DC.) U. Braun on *Ballota nigra* L, 12 VIII 2003.

21. *Microsphaera alphitoides* Griff. et Maubl. on *Querqus robur* L., 25 VII 2001; 17 VII 2002., 12 VIII 2003, 20 VIII 2004.

22. *Microsphaera trifolii* (Grev.) U. Braun on *Trifolium pratense* L., 15 VII 2002, 12 VIII 2003.

23. *Podosphaera xanthii* (Castagne) U. Braun & Shishkoff on *Xanthium spinosum* L, 12 VIII 2003.

24. *Sawadaea bicornis* (Wallr.) Homma on *Acer campestre* L; 18 VII 2001, 12 VIII 2003.

Subclass Leotiomycetidae
Order Helotiales
Family Dermateaceae

25. *Monilinia fructigena* Honey
on *Malus pumila* Mill, 23 VI 1998, 16 VII 2002,
on *Malus sylvestris* (L.) Miller, 26 VIII 2003 ;
on *Chaenomeles japonica* (Thumb) Lindl., 26 VIII 2003;
on *Chaenomeles cathayensis* Sch., 26 VIII 2003;
on *Cornus mas* L., 26 VIII 2003.

Order Rhytismatales
Family Rhytismataceae

26. *Rhytisma acerinum* (Pers.) Fr.
on *Acer platanoides* L., 12 VIII 2003;
on *Acer campestre* L, 12 VIII 2003.

Subclass Sordariomycetidae
Order Diaporthales
Family Gnomoniaceae

27. *Gnomonia juglandis* (DC.)Trav. on *Juglans regia* L., 15 VII 2002; 20 VIII 2004.

Order Hypocreales
Family Nectriaceae

28. *Nectria cinnabarina* (Tode) Fr. on *Sambucus nigra* L., 18 VII 2001; 2 X 2003.

Order Phyllachorales
Family Phyllachoraceae

29. *Colletotrichum hedericola* Laubert on *Hedera helix* L., 15 VII 2002.

Family Amphisphaeriaceae

30. *Pestalotiopsis funerea* (Desm.) Steyaert on *Thuja plicata* D. Don., 12 VII 2003.

Class Urediniomycetes
Subclass Incertae sedis
Order Uredinales
Family Coleosporaceae

31. *Coleosporium tussilaginis (Pers.) Lév.*
(II, III), on *Campanula trachelium* L., P.6, 18 VII 2001;
(II), on *Campanula bononiensis,* 31 VIII 2001;
(II), on *Melampyrum bihariense* Kern., 18 VII 2001; 15 VII 2002.

Family Melompsoraceae

31. *Melampsora epitea* var. *epitea* Thüm. (II), on *Salix caprea* L., 16 VII 2002.

33. *Melampsora populnea* (Pers.) P. Karst. (II, III), on *Populus tremula* L., 16 VII 2002.

Family Phragmidiaceae

34. *Phragmidium mucronatum* (Pers.) Schltdl. (II+III) on *Rosa canina* L., 4 XI 1998; 15 VII 2002.

Family Pucciniaceae

35. *Cumminsiella mirabilissima* (Peck) Nannf. (II), on *Mahonia aquifolium* (Pursch.) Nutt, 19 X 1998; (II, III), on *Mahonia aquifolium* (Pursch.) Nutt., 15 VII 2002.

36. *Puccinia aegopodii* (Schumach.) Link on *Aegopodium podagraria* L., 20 VIII 2004.

37. *Puccinia bardanae* (Wallr.) Corda (II, III) on *Arctium tomentosum* Miller., 4 IX 2001

38. *Puccinia calcitrapae* DC. (II, III) on *Carduus crispus* L., P.11, 4 IX 2001.

39. *Puccinia carthami* Corda (II, III) on *Centaurea phrygia* L., 18 VII 2001, 15 VII 2002.

40. *Puccinia convolvuli* (Pers.) Castagne (II, III) on *Calystegia sepium* (L.) R. Br, 20 VIII 2004.

41. *Puccinia menthae* Pers. (I, II), *Mentha longifolia* L. Nath., 20 VIII 2004.

42. *Puccinia tanaceti* DC. (II, III) on *Tanacetum corymbosum* (L.) Schultz-Bip., 20 VIII 2004.

43. *Puccinia violae* (Schumach.) DC. (II III), *Viola reichenbachiana* L., 12 VII 2004.

Conclusions

The researches effectuated between the years 1998 and 2004 contribute at the cognition of the biodiversity of the micromycetes in Dofteana Arboretum.

The species of micromycetes identified belong to: 2 kingdom, 3 phylums, 3 classes, 10 orders, 15 families, and 26 genera.

Rezumat

În lucrare, sunt prezentate un număr de 46 de specii de micromicete parazite şi saprofite pe 45 de plante, colectate din Arboretumul Dofteana (județul Bacău), în perioda 1998-2004.

Micromicete aparțin la 2 regnuri 3 încrengături, 10 ordine, 15 familii, 26 de genuri, în 60 de combinații ciupercă – plantă gazdă.

Din clasa Ascomicetes au fost determinate 27 de specii, din Basidiomicetes - 13 specii, iar din Oomycetes - 3 specii.

Dintre speciile de micromicete prezentate, 44 sunt semnalate pentru prima dată din zonă studiată.

Materialul micologic prezentat a fost intodus în colecția de ciuperci din cadrul Complexului Muzeal de Ştiințele Naturii „Ion Borcea" Bacău.

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I respectfully thank to Prof. Dr. Mihai Mititiuc for his guidance in the research and for the bibliography. The authors are grateful to the Bacau County Council and the "Ion Borcea" Natural Sciences Museum Complex for support of this research.

References

1. BRAUN UWE, 1987 - *A monograph of the Erysiphales (powdery mildews)*. Beih. Nova Hedwigia, Heft 89, Berlin, Stuttgart, J. Cramer, 700 pp.
2. CIOCÎRLAN V., 1990 - *Flora ilustrată a României*. Vol. I, II, Ed. Ceres, Bucureşti.
3. CONSTANTINESCU O., 1974 - *Metode şi tehnici în micologie*. Ed. Ceres, Bucureşti, 261 pp.
4. GEORGESCU C.C., BADEA M., 1937 - *O nouă specie de Cercospora parazită pe ace de Juniperus*. Anal. ICEF, II, Seria I, Bucureşti: 37-47.
5. GEORGESCU C. C., MOLDOVAN I., 1937 - *Considerațiuni asupra culturii răşinoaselor în parcul dendrologic de la Dofteana (Bacău)*. Anal. ICEF, II, Seria I, Bucureşti: 79-116.
6. MIHALACHE ANA, 1988 - *Monografia Arboretumului Dofteana*. Centrul de Material Didactic şi Propagandă Agricolă, Bucureşti, 134 pp.
7. PETRESCU M., NEGREAN G., 1994 - *Uredinalele de pe speciile de Populus din România (I)*. St. cerc. biol., Seria biol. veget., t. 46, nr. 1, Bucureşti: 13-21.
8. RĂDULESCU E., NEGRU AL., DOCEA E., 1973 – *Septoriozele din România*. Ed. Academiei R. P. R., Bucureşti, 325 pp.
9. SANDU - VILLE C., 1967 - *Ciupercile Erysiphaceae din România - studiu monografic*. Ed. Academiei R.S. Române, Bucureşti, 358 pp.
10. SANDU - VILLE C., 1971 - *Ciuperci Pyrenomycetes - Sphaeriales din România*. Ed. Academiei R. S. Române, Bucureşti, 409 pp.
11. SĂVULESCU TR., 1953 - *Monografia Uredinalelor din Republica Populară Română*. Vol. I-II, Ed. Academiei R. P. Române, Bucureşti, 1166 pp.
12. SĂVULESCU TR., SĂVULESCU OLGA, 1964 - *Peronosporaceele din Republica Populară Română*. Acta Bot. Horti. Bucurestiensis, Bucureşti, 146 pp.
13. TĂNASE C., 2002 - *Micologie, Manual de lucrări practice*. Ed. Universității "Alexandru Ioan Cuza", Iaşi, 227 pp.
14. ***http://rbg-web2.rbge.org.uk/FE/fe.html
15. *** http://www.indexfungorum.org/

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 45 – 53

THE BIODIVERSITY OF THE MACROMYCETES IN THE DOFTEANA ARBORETUM, BACAU COUNTY

OTILIA CARMEN PAVEL*

ABSTRACT

PAVEL C. O., 2006 - The biodiversity of the macromycetes in the Dofteana Arboretum, Bacau county. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 45-53.

The identified macromycetes, in number of 195 are from the Fungi kingdom and they belong to two phylums Ascomycota and Basidiomycota, 2 classes, 14 orders and 48 families, 95 genera. From the numerical analysis, it results that the predominant species from the orders: Agaricales – 91 species, Russulales – 29 species, Polyporales -26 species, Boletales - 20 species. The macromycetes species belong to 8 biological forms and 9 ecological categories. The ecological spectrum is dominated by saprotrophic species – 104 (53 %), followed by mycorhizes species - 61 (31 %). From the economic importance point of view the most numerous are the inedible species – 125 (65%), followed by the edible species – 57 (29 %) and toxic 13 (7 %).

Key words: macromycetes, bioform, ecological category, diversity, Dofteana , Bacău

Introduction

The Dofteana Arboretum is situated in the region of Nemira Mauntains, and it spreads on the medium terrace of Dofteana valley (in Bacău county) at the south-eastern of Hăghiac village. The total surface of the park is of 34 hectares, between 46˚21′ N latitude and 26˚32′ E longitude, at altitude of 370 - 430 m.

It was founded between 1908 and 1910 by the arrangement of a common made by Iuliu Moldovan who worked for 25 years for the acclimatization of the exotic species.

At Dofteana, where the Arboretum is situated, there is a temperate climate, specific to the intramontane depressions; the annual temperature is 9,3˚ C and the mean annual precipitation 612,3 mm.

The flora epithome contains a number of 635 tree species and 237 herbaceous species and moses.

The dendrological collections lies on a surface of 24 hectares, in the western part of the arboretum, on a surface of 10 hectares there lay an oak hornbeam forest.

Material and method

Fungi were investigated macroscopically and microscopically. The examinations was effectuated at the Olympus SZ61 stereomicroscope and at the Olympus CX 31 microscope.

The collected material was determined using the mycological literature (1, 2, 3, 4, 5, 6, 7, 8, 9, 10). The classification and the nomenclature of the species were updated according to Index Fungorum (11) for macromycetes.

The classification of the macromycetes depending on the bioform (life form), the food value, the toxicity, was made after G. Sălăgeanu, 1985 (10).

During the period from 1998 to 2004 examinations were made upon the macromycetes, from May to November in the following vegetal formations: oak hornbeam forest, collection of larch trees, of pine trees, of spruce trees, of fir trees.

The mycological material was preserved and introduced in the collection of macromycetes of the Museum of Natural Sciences from Bacău.

Results and discussions

The researches effectuated between the years 1998 and 2004 contribute at the cognition of the biodiversity of the macromycetes in Dofteana Arboretum.

The identified macromycetes, in number of 195 are from the Fungi kingdom and they belong to

* "Ion Borcea" Natural Sciences Museum Complex

two phylums Ascomycota and Basidiomycota, 2 classes, 14 orders and 48 families, 95 genera. A taxonomically arranged list of all the species collected is reported in a table (Tab. 1). The macromycetes are put in the alphabetical order of families, genera and species, at each species it is noted the life form, the ecological category and the economic importance.

The macromycetes from Ascomycetes class are in a number: 13 species, belonging to 11 genera, 4 families, 3 orders and 3 subclasses.

The macromycetes from Basidiomycota class have the highest prevalence of 93 % (182) and they belong to genera, 44 families, 11 orders.

From the numerical analysis, it results that the predominant species from the orders: Agaricales – 91 species, Russulales – 29 species, Polyporales - 26 species, Boletales - 20 species (fig. 1).

The families with the largest number of species are: Tricholomataceae - 29 species, Russulaceae - 24 species, Agaricaceae - 21 species, Marasmiaceae - 19 species, Polyporaceae -16 species.

The genera which have a significant prevalence: Russula – 21 species, Amanita -7 species, Clitocybe – 7 species.

The macromycetes species belong to 8 biological forms and 9 ecological categories (Table 1, fig. 2). The biological forms analysis shows the predominance of mycetogeophytes –57 %, followed by the mycetoepiphytes – 25 %. From the macromycetes, prevalent from the biodiversity and quantity pointy of view are the mycetogeophytes: Gm – 61species (31%), Gs - 49 species (25%).

The ecological spectrum is dominated by saprotrophic species – 104 (53 %), followed by mycorrhizes species - 61 (31 %). From the ecologic analysis of the categories one can see that the saprotrophic species on dead wood - 48 (25%), the saprotrophic species on soil or humus – 36 (18%).

The species that are frequent in the Dofteana Arboretum: *Agaricus silvicola* (Vitt.) Peck, *Amanita rubescens* var. *rubescens* Pers., *Boletus chrysenteron* Bull., *Gymnopus dryophilus* (Bull.) Murrill, *Inocybe rimosa* (Bull.) P. Kumm., *Macrolepiota procera* (Scop.) Singer, *Mycena pura* (Pers.) P. Kumm., *Russula foetens* (Pers.) Pers., *Russula turci* Bres., *Suillus granulatus* (L.) Snell, from terricolous sinusia and *Armillaria mellea* (Vahl) P. Kumm., *Hypholoma fasciculare* (Huds.) P. Kumm., *Stereum hirsutum* (Willd.) Pers., *Trametes versicolor* (L.) Lloyd. from epixylous sinusia.

Concerning the economic importance, the most numerous species are the inedible species – 125 (65%), followed by the edible species – 57 (29 %) and toxic 13 (7 %). Of the edible fungi, 35 species have a low food value (X), 11 have a medium food value (XX) and 11 species have a very high food value (XXX).

The toxic species belong to 3 groups: 6 species which produce gastro – intestinal intoxication (†), 5 species which produce intoxication of the nervous system (††), and 2 species which cause lethal intoxication.

Tab. 1 - The mycological material collected

Species **Kingdom FUNGI**	Biological form	Ecological category	Food values/ Toxicity/ Inedible	Habitat					
				1	**2**	**3**	**4**	**5**	**6**
Phylum ASCOMYCOTA, Class Ascomycetes Subclass Leotiomycetidae Order Helotiales Family Helotiaceae									
Ascocoryne sarcoides (Jacq.) J.W. Groves & D.E. Wilson	EPx	Sl		-	+	-	-	-	-
Bisporella citrina (Batsch) Korf & Carpenter	EPx	Sl		-	+	-	-	-	-
Chlorociboria aeruginascens (Nyl.) Kanouse ex C.S. Ramamurthi, Korf & L.R. Batra	EPx	Sl		-	+	-	-	-	-
Hymenoscyphus fructigenus (Bull.) Fr.	EPx	Sl		-	+	-	-	-	-
Subclass Pezizomycetidae									
OrderPezizales									
Family Helvellaceae									
Helvella crispa (Scop.) Fr	Gs	St		-	+	-	-	-	-
Family Pezizaceae									
Peziza badia Pers. Ex Fr.	Gs	St		-	+	-	-	-	-
Subclass Sordariomycetidae, Order Xylariales **Family Xylariaceae**									
Daldinia concentrica (Bolton) Ces. & De Not	EPx	Sl		-	+	-	-	-	-

Xylaria hypoxylon (L.) Grev.	EPx	Sl		-	+	-	-	-	-
Xylaria polymorpha (Pers.) Grev	EPx	Sl		-	+	-	-	-	-
Hypoxylon fragiforme (Pers.) J. Kickx	EPx	Sl		-	+	-	-	-	-
Hypoxylon fuscum (Pers.) Fr	EPx	Sl		-	+	-	-	-	-
Hypoxylon variolosum (L.) Keissl	EPx	Sl		-	+	-	-	-	-
Kretzschmaria deusta (Hoffm.) P.M.D. Martin	EPx	Sl		-	+	-	-	-	-
Phylum Basidiomycota, Class Basidiomycetes Subclass Agaricomycetidae Order Agaricales Family Agaricaceae									
Agaricus arvensis Schaeff..	Gs	St	XXX	+	-	-	-	-	-
Agaricus essettei Bon	Gs	St			+	-	-	-	-
Agaricus silvaticus Schaeff.	Gs	St	XX	-	+	+	-	-	-
Agaricus silvicola (Vitt.) Peck	Gs	St	XX	-	+	+	+	-	-
Agaricus xanthodermus Genev.	Gs	St	†	-	+	-	-	-	-
Coprinus comatus (O.F. Müll.) Gray	Th	St		-	+	-	-	-	-
Coprinus disseminatus (Pers.) Gray	Th	Sh-Sl		-	+	-	-	-	-
Coprinus micaceus (Bull.) Fr.	Th	Sh-Sl		-	+	+	+	+	+
Lepiota cristata (Bolton) P. Kum	Gs	St		-	+	+	+		
Macrolepiota procera (Scop.) Singer	Gs	St	XXX	-	/+	+	+	+	+
Macrolepiota puellaris (Fr.) M.M. Moser	Gs	St		-	-	-	+	-	-
Macrolepiota rhacodes (Vittad.) Singer	Gs	St	XXX	-	+	+	+	+	+
Family Bolbitiaceae									
Agrocybe pediades (Fr.) Fayod	Gs	St	X	+	-	-	-	-	-
Panaeolus sphinctrinus (Fr.) Quél.	Th	Sc		+	+	-	-	+	-
Family Cortinariaceae									
Galerina marginata (Batsch) Kühne	EPx	Sl		-	+	-	-	-	-
Inocybe asterospora Quél.	Gm	M		-	-	+	-	-	-
Inocybe cookei Bres.	Gm	M	††	-	+	-	+	-	-
Inocybe glabripes Rick	Gm	M		-	+	-	-	-	-
Inocybe geophylla (Pers.) P. Kumm.	Gm	M		-	+	-	-	+	-
Inocybe rimosa (Bull.) P. Kumm.	Gm	M	††	-	+	+	+	+	-
Family Entolomataceae									
Clitopilus prunulus (Scop.) P. Kumm	Gs	St	XXX	-	+	+	-	-	-
Entoloma hirtipes (Schumach.) M.M. Moser	Gs	St		-	+	-	-	-	-
Family Fistulinaceae									
Fistulina hepatica (Schaeff.) With.	Ex-EPx	SPl		-	+	-	-	-	-
Family Hydnangiaceae									
Laccaria amethystina Cooke	Gm	M	XX	-	+	-	+	-	-
Laccaria laccata (Scop.) Fr.	Gm	M	X	-	+	-	-	-	-
Family Lycoperdaceae									
Bovista plumbea Pers.	Gs	St	X	+	+	-	-	-	-
Handkea excipuliformis (Scop.) Kreisel	Gs	St	X	+	+	-	-	-	-
Handkea utriformis (Bull.) Pers	Gs	St	X	+	-	-	-	-	-
Lycoperdon perlatum Pers	Gs	St		-	+	+	+	+	-
Lycoperdon pyriforme Schaeff	EPx	Sl		-	+	-	-	-	-
Family Marasmiaceae									
Armillaria mellea (Vahl) P. Kumm.	Ex-EPx	SPl	XX	-	+	-	-	-	-
Flammulina velutipes (Curtis) Singer	Ex-EPx	SPl	X	-	+	-	-	-	-
Marasmiellus candidus (Bolton) Singer	EPx	Sl		-	+	+	+	-	-
Marasmiellus ramealis (Bull.) Singer	EPx	Sl		-	+	+	+	-	+
Marasmius androsaceus (L.) Fr.	Gs	Sf		-	-	+	+	-	-
Marasmius epiphylus (Pers. Ex Fr.) Fr.	Gs	Sf		-	+	-	-	-	-
Marasmius cohaerens (Alb. & Schwein.) Cooke & Quél	Gs	Sf		-	+	-	-	-	-
Marasmius oreades (Bolton) Fr	Gp	St	XXX	+	-	-	-	-	-
Marasmius rotula (Fr. Ex Scop.) Fr.	EPx-Gs	Sl		-	+	-	-	-	-

Marasmius wynnei Berk. & Broom	Gs	Sf		-	-	+	+	-	-
Micromphale foetidum (Sowerby) Singer	EPx	Sl		-	+	-	-	-	-
Micromphale brassicolens var. brassicolens (Romagn.) P.D. Orton	Gs	Sf		-	-	-	+	-	-
Rhodocollybia butyracea f. butyracea (Bull.) Len	Gs	St		-	-	+	+	-	-
Xerula radicata (Relhan) Dörfelt	Gs-EPx	Sl		-	+	-	-	-	-
Family Nidulariaceae									
Crucibulum laeve (Huds.) Kambly	EPx	Sl		-	+	-	-	-	-
Cyathus striatus (Huds.) Willd	EPx-Gs	Sf-Sl		-	+	+	-	-	-
Family Pleurotaceae									
Pleurotus cornucopiae Paul.ex Fr.	Ex-EPx	SPl	XX	-	+	-	-	-	-
<u>Family Pluteaceae</u>				-					
Amanita citrina var. *citrina* (Schaeff.) Pers.	Gm	M	†	-	+	-	+	+	-
Amanita muscaria var. muscaria (L.) Lam.	Gm	M	††	-	+	+	+	+	+
Amanita pantherina Gonn. & Rabenh.	Gm	M	††	-	+	-	-	-	-
Amanita phalloides (Vaill. Ex Fr.) Link,	Gm	M	†††	-	+	+	+	+	+
Amanita rubescens var. *rubescens* Pers.	Gm	M	XXX	-	+	+	+	+	+
Amanita vaginata (Bull.) Lam.	Gm	M	†	-	+	-	-	-	+
Amanita spissa (Fr.) P. Kumm.	Gm	M	X	-	-	-	+	-	-
Pluteus cervinus P. Kumm.	EPx	Sl	X	-	+	-	-	-	-
Family Psathyrellaceae									
Coprinopsis atramentaria (Bull.) Redhead, Vilgalys & Moncalvo	Th	St	†	-	+	-	-	-	-
Psathyrella candolleana (Fr.) Maire	Gs	St	X	-	+	-	-	-	-
Family Sclerodermatacea									
Scleroderma verrucosum (Bull.: Pers.) Pers	Gm	M	†		+	-	-	-	-
Family Schizophyllaceae									
Schizophyllum commune Fr.	Ex-EPx	SPl		-	+	-	+	-	-
Family Strophariaceae									
Hypholoma capnoides (Fr.) P. Kumm.	EPx	Sl		-	-	+	+	-	-
Hypholoma fasciculare (Huds.) P. Kumm	EPx	Sl	†	-	+	+	+	+	-
Stropharia aeruginosa (Curtis) Quél.	Gs	St		-	-	+	+	+	-
Family Tricholomataceae									
Clitocybe alexandri (Gillet) Konrad	Gs	St		-	-	-	+	-	-
Clitocybe candicans (Pers.) P. Kumm.	Gs	Sf		-	-	-	+	+	-
Clitocybe dealbata (Sowerby) Gillet	Gs	Sf	†††	+	-	-	-	-	-
Clitocybe gibba (Pers.) P. Kumm	Gs	Sf	X	-	-	+	+	+	-
Clitocybe inornata (Sowerby) Gillet	Gs	Sf		-	-	+	-	-	-
Clitocybe nebularis (Batsch) Quél.	Gs	St		-	+	-	-	-	-
Clitocybe odora (Bull.) P. Kumm	Gs	Sf	X	-	+	+	+	+	+
Gymnopus confluens (Pers.) Antonín	Gs	Sf		-	+	-	-	+	-
Gymnopus dryophilus (Bull.) Murrill	Gs	Sf	X	-	+	+	+	+	+
Gymnopus fusipes (Bull.) Gray	Ex-EPx	SPl		-	+	-	-	-	-
Gymnopus peronatus (Bolton) Antonín	Gs	Sf		-	+	+	+	+	+
Hygrocybe chlorophana (Fr.) Wünsche	Gs	St	X	+	-	-	-	-	-
Hygrocybe coccinea (Schaeff.) P. Kumm.	Gs	St	X	+	-	-	-	-	-
Hygrocybe conica (Scop.) P. Kumm.	Gs	St	X	+	-	+	+	-	-
Hygrocybe psittacina (Schaeff.) P. Kumm.	Gs	St		+	-	+	-	-	-
Lepista irina (Fr.) H.E. Bigelow	Gs	St		-	+	-	-	-	-
Lepista inversa (Scop.) Pat.	Gs	St	X	-	-	+	+	+	+
Melanoleuca grammopodia (Bull.) Murrill	Gs	St	X	-	+	-	-	-	-
Megacollybia platyphylla (Pers.) Kotl. & Pouzar	EPx	Sl		-	+	-	-	-	-
Mycena epipterygia var. epipterygia (Scop.) Gray	EPx	Sl		-	+	+	+	+	+
Mycena galericulata (Scop.) Gray	Ex-EPx	SPl		-	+	-	-	-	-
Mycena inclinata (Fr.) Quél.	Ex-EPx	SPl		-	+	-	-	-	-
Mycena polygramma (Bull.) Gray	Ex-EPx	SPl		-	+	-	-	-	-
Mycena pura (Pers.) P. Kumm	Gs	Sf		-	+	+	+	+	-

Mycena rosea (Schumach.) Grambe	Gs	Sf		-	-	-	+	-	-
Mycena vitilis (Fr.) Quél.	Gs	St		-	+	-	-	-	-
Tricholoma myomyces (Pers.) J.E. Lange	Gm	M		-	+	-	-	-	-
Tricholoma portentosum (Fr.) Quél	Gm	M		-	-	-	+	-	-
Tricholomopsis rutilans (Schaeff.) Singer	EPx	Sl		-	-	-	-	-	+
Order Auriculariales Family Auriculariaceae									
Auricularia auricula-judae (Fr.) Quél.	EPx	Sl	X	-	+	-	-	-	-
Auricularia mesenterica (Dicks.) Pers.	Ex-EPx	SPl		-	+	-	-	-	-
Order Boletales									
Family Boletacea									
Boletus aereus Bull	Gm	M	XXX	-	+	-	-	-	-
Boletus badius (Fr.) Fr.	Gm	M	XX	-	-	-	+	-	-
Boletus edulis Bull.	Gm	M	XXX	-	-	+	+	-	-
Boletus chrysenteron Bull.	Gm	M	X	-	+	+	+	+	+
Boletus ferrugineus Boud.	Gm	M	X	-	+	-	-	-	-
Boletus luridus Schaeff.	Gm	M			+	-	-	-	-
Boletus queletii Schulzer	Gm	M	X						
Family Coniophoraceae									
Coniophora puteana (Schumach.) P. Karst.	EPx	Sl		-	+	-	-	-	-
Family Gomphidiaceae									
Chroogomphus helveticus (Singer) M.M. Moser	Gm	M		-	-	-	+	-	-
Chroogomphus rutilus (Schaeff.) O.K. Mil	Gm	M	X	-	-	-	+	+	-
Gomphidius glutinosus (Schaeff.) Fr.	Gm	M	XX	-	-	-	-	+	-
Family Hygrophoropsidaceae									
Tapinella atrotomentosa (Batsch) Šutara	EPx	Sl		-	-	-	+	+	-
Family Paxillaceae									
Paxillus filamentosus Fr.	Gm	M		-	+	-	-	-	-
Paxillus involutus (Batsch) Fr.	Gm	M		-	+	-	-	-	-
Family Suillaceae									
Suillus bovinus (Pers.) Kuntze	Gm	M	X	-	-	-	+	-	-
Suillus collinitus (Fr.) Kuntze	Gm	M	X	-	-	-	-	+	-
Suillus granulatus (L.) Snell	Gm	M	X	-	-	-	-	+	-
Suillus grevillei (Klotzsch) Singer	Gm	M	X	-	-	-	-	-	+
Suillus tridentinus (Bres.) Singer	Gm	M	X	-	-	-	-	-	+
Order Cantharellales **Family Cantharellaceae**									
Cantharellus cibarius Fr.	Gm	M	XXX	-	-	+	+	-	-
Cantharellus tubaeformis (Bull.) Fr	Gm	M	XXX	-	-	+	+	-	-
Order Dacrymycetales **Family Dacrymycetaceae**									
Calocera viscosa (Pers.) Fr.	EPx	Sl		-	+	-	-	-	-
Order Hymenomycetales				-					-
Family Hymenomycetaceae				-					-
Coltricia perennis (L.) Murrill	Gs	St		-	-	+	-	--	-
Hymenochaete rubiginosa (Dicks.) Lév	EPX	Sl		-	+	-	-	-	-
Family Schizoporaceae									
Hyphodontia quercina (Pers.) J. Erikss	EPX	Sl		-	+	-	-	-	-
Order Phallales **Family Geastraceae**									
Geastrum fimbriatum Fr	Gs	St		-	+	+	+	+	-
Geastrum striatum DC.	Gs	St		-	-	+	+	-	-
Family Gomphaceae									
Ramaria stricta (Pers.) Quél.	EPx	Sl		-	+	-	-	-	-
Ramaria apiculata (Fr.) Donk	EPx	Sl		-	-	+	+	-	-

Order Polyporales **Family Corticiaceae**									
Corticium laeve Fr.	EPx	Sl		-	+	-	-	-	-
Family Fomitopsidaceae									
Daedalea quercina (L.) Pers.	Ex-EPx	SPl		-	+	-	-	-	-
Fomitopsis pinicola (Sw.) P. Karst.	Ex-EPx	SPl		-	-	+	+	+	
FamilyGanodermataceae									
Ganoderma applanatum (Pers.) Pat	Ex-EPx	SPl		-	+	-	-	-	-
Ganoderma lucidum (Curtis) P. Karst.	Ex-EPx	SPl		-	+	-	-	-	-
FamilyGloeophyllaceae							-	-	-
Gloeophyllum abietinum (Bull.) P. Karst.	Ex-EPx	SPl		-	-	-	+	-	-
Gloeophyllum odoratum (Wulfen) Imazeki	Ex-EPx	SPl		-	+	+	+	+	+
Gloeophyllum sepiarium (Wulfen) P. Karst	EPx	Sl		-	-	-	+	-	-
FamilyHapalopilaceae									
Bjerkandera adusta (Willd.) P. Karst.	EPx	Sl		-	+	+	+	+	+
FamilyHyphodermataceae									
Hyphoderma puberum (Fr.) Wallr.	EPx	Sl		-	+	-	-	-	-
Family Meruliaceae									
Merulius corium Fr.	EPX	Sl		-	+	-	-	-	-
Merulius tremellosus Schrad	Epx-EPx	SPl		-	+	-	-	-	-
Family Polyporaceae									
Cerrena unicolor (Bull.) Murrill	Ex-EPx	SPl		-	+	-	-	-	-
Daedaleopsis confragosa (Bolton) J. Schröt.	Ex-EPx	SPl		-	+	-	-	-	- -
Fomes fomentarius (L.) J.J.Kickx	Ex	Pl		-	+	-	-	-	-
Laetiporus sulphureus (Bull.) Murrill	Ex	Pl	X	-	+	-	-	-	-
Lenzites betulina f. variegata (Fr.) Donk	EPx	Sl		-	+		-	-	-
Phaeolus schweinitzii (Fr.)	Ex	Pl		-	-	+	-	-	-
Polyporus arcularius (Batsch) Fr.	EPx	Sl		-	+	-	-	-	-
Polyporus varius (Pers.) Fr	Ex-EPx	SPL			+	-	-	-	-
Lentinus strigosus (Schwein.) Fr.	Ex-EPx	SPl							
Skeletocutis nivea (Jungh.) Jean Keller	EPx	Sl		-	+	-	-	-	-
Trametes gibbosa (Pers.) Fr.	EPx	Sl		-	+	-	-	-	-
Trametes hirsuta (Wulfen) Pilá	EPx	Sl		-	+	-	-	-	-
Trametes versicolor (L.) Lloyd	EPx	Sl		-	+	+	+	+	+
Trametes pubescens (Schumach.) Pilát	Ex-EPx	SPl		-	+	-	-	-	-
Order Russulales **Family_Bondarzewiaceae**									
Heterobasidion annosum (Fr.) Bref	Ex-EPx	SPl		-	-	+	+	+	+
Family Peniophoraceae									-
Peniophora laeta (Fr.) Donk	EPx	Sl		-	+	-	-	-	-
FamilyRussulaceae									
Lactarius deliciosus (L.) Gray	Gm	M	X	-	-	+	-	-	-
Lactarius deterrimus Gröger	Gm	M	X	-	-	-	+	-	-
Lactarius vellereus (Fr.) Fr.	Gm	M	X	-	+	-	-	-	-
Russula albonigra (Krombh.) Fr.	Gm	M		-	+	+	-	-	-
Russula adusta (Pers.) Fr.	Gm	M		-	+	-	-	-	-
Russula alutacea (Fr.) Fr.	Gm	M		-	+	-	-	-	-
Russula atropurpurea (Krombh.) Britzelm	Gm	M	X	-	+	-	-	-	-
Russula cyanoxantha (Schaeff.) Fr	Gm	M	XX	-	+	+	+	+	-
Russula delica Fr	Gm	M	XX	-	+	-	-	-	-
Russula fellea (Fr.) Fr.,	Gm	M		-	+	-	-	-	-
Russula foetens (Pers.) Pers.	Gm	M		-	+	+	+	+	-
Russula grisea (Batsch) Fr.	Gm	M	X	-	+	-	-	-	-
Russula heterophylla (Fr.) Fr.	Gm	M	XX	-	+	+	+	+	-
Russula integra var. integra (L.) Fr.	Gm	M	X	-	-	+	+	+	+

Russula nauseosa (Pers.) Fr.,	Gm	M	X	-	-	-	+	-	-
Russula ionochlora Romagn.	Gm	M		-	+	-	-	-	-
Russula nigricans (Bull.) Fr.	Gm	M		-	+	-	-	-	-
Russula rhodopoda Zvara	Gm	M		-			+		-
Russula sanguinaria (Schumach.) Rauschert	Gm	M	††	-	+	-	-	-	-
Russula sardonia Fr.	Gm	M		-	-	-	-	+	-
Russula turci Bres.	Gm	M		-	-	-	-	+	-
Russula sororia Fr.	Gm	M		-	+	-	-	+	-
Russula vesca Fr.	Gm	M	XX		+	-	+	-	-
Russula virescens (Schaeff.) Fr	Gm	M	XXX	-	+	+	+	-	-
Family Stereaceae				-		-	-		
Aleurodiscus croceus Pat.	EPx	Sl		-	+	-	-	-	-
Stereum hirsutum (Willd.) Pers	Ex-EPx	SPl		-	+	-	-	-	-
Xylobolus frustulatus (Pers.) Boidin	Ex-EPx	SPl		-	+	-	-	-	-
Chondrostereum purpureum (Pers.) Pouza	EPx	Sl		-	+	-	-	-	-
Order Thelephorales FamilyThelephoraceae									
Thelephora terrestris Ehrh.	GM	M		-	+	-	-	-	-
Subclass Tremellomycetidae, Order Tremellales **Fam Exidiaceae**									
Exidia glandulosa (Bull.) Fr.	Ex-EPx	SPl		-	+	-	-	-	-
Exidia saccharina Fr.	EPx	Sl		-	-	+	-	-	-
Family Tremellaceae									
Tremella mesenterica Retz	EPx	Sl		-	+	-	-	-	-
Total 195				12	140	55	65	42	22
Biological form									
Gm - mycetogeophyta mycorrhiza (micorrhizant mushrooms)	61 (31%)				38	17	26	19	8
Gs - mycetogeophyta saprophytica (saprophyte mushrooms whose mycelium is in the soil or in places characterized by plenty of remains of herbaceous plants, fruit, and leaves fell down)	49 (25%)			10	28	23	23	12	6
Gp – mycetogeophyta parasitica (mushrooms whose mycelium is in the underground plant organs)	1 (0,5 %)			1					
Th – mycetotherophyta (short living mushrooms)	5 (2,6 %)			1	5	1	1	2	1
EPx – mycetoepixilophyta (mushrooms whose life cycle takes place on dead wood)	46 (24%)				42	9	10	5	5
EPx-Gs – mycetoepixilophyta - mycetogeophyta saprophytica	3 (1,5%)				3	1			
Ex – mycetonedoxilophyta (mushrooms whose life cycle takes place in the body of the wooden plants)	3 (1,5 %)				2	1			
Ex-EPx - mycetonedoxilophyta - mycetoepixilophyta	27 (14%)				23	3	5	3	2
Ecological category									
M - mycorrhizal species		61			38	17	26	19	8
Sf - saprothrophic species on leaf		16		1	7	7	10	7	3
St - saprothrophic species on soil or humus		36		10	24	16	13	6	3
Sc - coprophilous species		1		1	1			1	
Sl - saprothrophic species on dead wood		48			43	9	10	4	5
SPl - saproparasite species on wood		27			23	3	5	3	2
Pl - parasite species on living trees		3			2	1			
Sh-Sl - saprothrophic on humus or on dead wood		1			2	1	1	1	1
Sf-Sl - saprothrophic on leaf or on dead wood		2			1	1			
Food values			**57**	**9**	**31**	**19**	**24**	**16**	**10**
X – eatable with little food value			35	7	16	9	11	10	7
XX - eatable with a lot of food value			11		9	2	6	3	

XXX - eatable with great food value			11	2	6	8	7	3	3
Inedible – without sign			**125**	**2**	**97**	**22**	**35**	**21**	**9**
Toxicity			**13**	**1**	**12**	**4**	**6**	**5**	**3**
† - mushrooms wich cause gastrointestinal intoxication			6		6	1	2	2	1
†† - mushrooms wich cause intoxication of the nervos system			5		5	2	3	2	1
††† - mushrooms wich cause fatal intoxication			2	1	1	1	1	1	1
Habitat: 1 - maedow, 2 - oak hornbeam forest, 3 - collection - genus *Abies (firs)*, 4 - collection - genus *Picea (spruces)*,5 - collection - genus *Pinus (pines)*, 6 - collection - genus *Larix (larchs)*.									

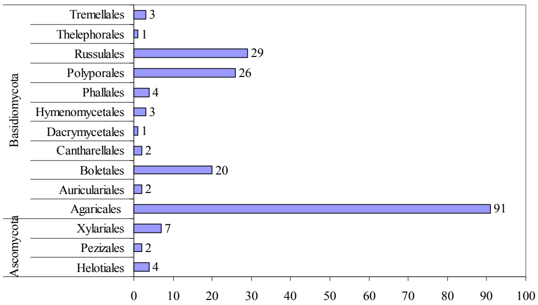

Fig.1 - The number of species on orders

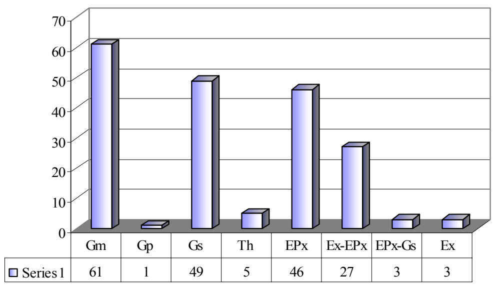

Fig.2 - Bioforms spectrum of the macromycetes

Conclusions

The study was carried out through six years in the Dofteana Arboretum.

The 195 species of macromycetes identified belong to: 2 phylums, 2 classes (13 -Ascomycetes and 182 -Basidiomycetes), 14 orders, 48 families, 95 genera.

The macromycetes species belong to 8 biological forms and 9 ecological categories. The bioforms spectrum is dominated by mycetogeophytes – 57 % and the ecological spectrum is dominated by saprotrophic species – 104 (53 %),

From the economic importance point of view the most numerous are the inedible species – 125 (65%), followed by the edible species – 57 (29 %) and toxic 13 (7 %).

The mycological material was preserved and introduced in the collection of Macromycetes of the Museum of Natural Sciences in Bacău.

Rezumat

În lucrare sunt prezentate cercetările realizate între anii 1998-2004, privind diversitatea macromicetelor din Arboretumul Dofteana, din județul Bacău. Au fost identificate un număr de 195 de specii de macromicete din regnul Fugi, care se incadrează în 2 încrengături, 2 clase, 14 ordine, 48 de familii, 95 de genuri. Din Ascomycota au fost identificate 13 specii ce aparțin la 10 genuri, 4 familii, 3 ordine şi 3 subclase. Macromicetele din încrengătura Basidiomycota aparțin la 85 de genuri, 44 familii, 11 ordine, 2 subclase. Genurile cu pondere semnificativă sunt: Russula - 21 specii, Amanita -7 specii, Clitocybe - 7 specii. Analiza numerică a macromicetelor în funcție de formația vegetală relevă faptul că cele mai multe specii au fost colectate din pădurea de foioase (140 specii, 72%)

Spectrul formelor biologice este dominat de mycetogeophyte – 57 %, iar spectrul ecologic este dominat de speciile saprofite – 104 (53 %), urmate de speciile micorizante - 61 (31 %).

Din puct de vedere economic predomină speciile necomestibile - 125 specii (64 %), urmate de cele comestibile – 57 specii (29 %) şi toxice - 13 specii (7 %).

Din zona studiată, menționez următoarele specii caracteristice: *Agaricus silvicola* (Vitt.) Peck, *Amanita rubescens* var. *rubescens* Pers., *Boletus chrysenteron* Bull., *Gymnopus dryophilus* (Bull.) Murrill, *Inocybe rimosa* (Bull.) P. Kumm., *Macrolepiota procera* (Scop.) Singer, *Mycena pura* (Pers.) P. Kumm., *Russula foeten*s (Pers.) Pers., *Russula turci* Bres., *Suillus granulatus* (L.) Snell, din sinuzia tericolă; *Armillaria mellea* (Vahl) P. Kumm., *Hypholoma fasciculare* (Huds.) P. Kumm., *Stereum hirsutum* (Willd.) Pers., *Trametes versicolor* (L.) Lloyd. din sinuzia epixilă.

Acknowledgments

I want want to express my gratitude towards Professor Doina Toma who put at my disposal specific literature.

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References

1. APOSTOL L., 2004 – *Clima subcarpaţilor Moldovei*. Ed. Universitatea Suceava, Suceava: 106 - 208.
2. BECKER G., 2000 – *Champignons*. Gründ, Paris, 223 pp.
3. BON M., 1988 - *Champignons de France et d'Europe Occidentale*. Ed. Arthaud, Paris, 345 pp.
4. BON M., 1990 – *Les Hygrophores. Hygrophoraceae Lotsy*. Flore Mycologique d'Europe, 1, Documents Mycologiques, Mémoire Hors série N°1 , 99 pp.
5. BON M., 1991 – *Les Tricholomes et ressemblents*. Flore Mycologique d'Europe, 2, Documents Mycologiques, Mémoire Hors série N° 2, 153 pp.
6. BON M., 1993 – *Les Lépiotes. Lepiotaceae Roze*. Flore Mycologique d'Europe, 3, Documents Mycologiques, Mémoire Hors série N°4, 153 pp.
7. BON M., 1997 – *Les Clitocybes, Omphales et ressemblants*. Flore Mycologique d'Europe, 4, Documents Mycologiques, Mémoire Hors série N° 4, 181 pp.
8. BON M., 1999 - *Collybio-Marasmïoïdes et ressemblants*. Flore Mycologique d'Europe, 5, Documents Mycologiques, Mémoire Hors série N°5, 171 pp.
9. MIHALACHE A., 1988 - *Monografia Arboretumului Dofteana*. Centrul de Material Didactic şi Propagandă Agricolă, Bucureşti, 134 pp.
10. SĂLĂGEANU GH., SĂLĂGEANU A., 1985 - *Determinator pentru recunoaşterea ciupercilor comestibile, necomestibile şi otrăvitoare din România*, Ed. Ceres, Bucureşti, 310 p.
11. *** http://www.indexfungorum.org/Names/.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE BIODIVERSITY OF THE MICROMYCETES IN THE HEMEIUŞ ARBORETUM, BACĂU COUNTY

OTILIA CARMEN PAVEL*

ABSTRACT

PAVEL C. O., 2006 - The biodiversity of the micromycetes in the Hemeius Arboretum, Bacău county. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 54-58.

The autor presents a number of 102 micromycete, living on 142 plants, in 178 fungi - host plants combinations which were gathered in 1998 - 2005 from Hemeiuş Arboretum. The species of micromycetes identified belong to: 2 kingdom, 3 phylums, 3 classes (8 - Oomycetes, 63 - Ascomycetes and 30 - Basidiomycetes), 13 orders, 23 families, and 47 genera. Among these are 15 new combinations from Romania.

Key words: micromycetes, biodiversity, Hemeiuş, Bacău

Introduction

The Hemeiuş Arboretum is situated in the area of Hemeiuş village, 10 km away from Bacău.

From the geographical point of view, it is situated at the west border of the Moldavian Plateau, at the collision with the Moldavian Subcarpathians, in a Bistriţa river meadow, having geographical coordinates: 46° 37' 0" N latitude, 26° 51' 0" E longitude, altitude of 157 m.

The climate is continental, characteristic to the hilly land with wide depressions. The mean annual temperature is 9,2˚ C and the mean annual precipitation is 544 mm.

The Hemeiuş Arboretum lies on a 49,5 ha containing 10 ha of larch trees and pine plantations, 2 ha of clonal collections with species of local and exotic spruce fir, 20 ha of riparian mixed forest, 15 ha of dendrological collection and glades, 1,5 ha of nursery and 1 ha of administrative land (4).

From the specific literature concerning the scientific reservations of Hemeiuş, one can see that the flora of this field contains almost 1700 taxa of which the dendrological collections contains almost 1060 taxa (187 of coniferous species and 873 of deciduous species), the roses collection has 210 taxa and the rest is represented by the spontaneous flora.

A. Simionescu and his co-workers ellaborated a work of synthesis in which they presented data concerning the condition of woods in Romania between 1986 and 2000. The work contains data (ICAS Hemeiuş) concerning the attack of some diseases caused by the parasite fungi to the trees and to the bushes (10).

The research had as a goal the cognition of the diversity of the micromycetes in the area which was not studied from the mycological point of view.

Material and method

The mycological material was collected while itinerary trips.

The examinations was effectuated at the Olympus SZ61 stereomicroscope and at the Olympus CX 31 microscope.

The determination of micromycetes species was done according to literature (1, 5, 6, 7, 8, 9).

The classification and the nomenclature of the species were updated according to Index Fungorum (13).

The species are presented alphabeticaly in the famylis and in the classes, they belong to two different kingdoms: Chromista and Fungi.

The mycological material was preserved and introduced in the collection of micromycetes of the Museum of Natural Sciences from Bacău.

Results and discussions

The species of micromycetes identified belong to: 2 kingdom, 3 phylums, 3 classes (8 - Oomycetes, 63 - Ascomycetes and 30 - Basidiomycetes), 13 orders, 23 families, and 47 genera.

After the origin of the host-plants from the total of the species - 102, we see that 63 taxa are indigenous, 34 exotic and 45 cultivated.

* "Ion Borcea" Natural Sciences Museum Complex

Parasite and saprophytes micromycetes have been identified on a number of 77 wooden species and 38 herbaceous species.

Among the species of order Uredinales found in the Hemeiuş Arboretum 13 are heteroic euforms and 17 are autoic euforms.

The paper presents 15 species of new host plants for micromycetes species previously reported on other host - plants for Romania (*).

The micromycetes are put in the alphabetical order of families, genera and species.

Kingdom Chromista

Phylum Oomycota

Class Oomycetes

Subclass Incertae sedis

Order Peronosporales

Family Albuginaceae

1. *Albugo candida* (Pers.) Kuntze on *Capsella bursa-pastoris* (L.) Medik., 24 IV 2004.

Family Peronosporaceae

2. *Plasmopara viticola* (Berk. et Kurt.) Berl. Et de Toni on *Vitis vinifera* L., 23 VI 1998, 3 V 1999, 20 VIII 2000, 24 VIII 2001, 2 VII 2004, 10 VII 2005.
3. *Plasmopara nivea* (Unger) J. Schröt on *Aegopodium podagraria* L., 2 VII 2004.
4. *Plasmopara pygmaea* (Unger) Schroter on *Anemone ranunculoides L.*, 13 IV 2002; 24 IV 2004.
5. *Bremia lactucae Regel* on *Arctium lappa* L., 24 VIII 2001.
6. *Bremia gemminata* (Unger) Kochman & T. Majewski on *Lapsana communis* L, 2 VII 2004.
7. *Bremia sonchi* Sawada on *Sonchus oleraceus* L., 2 VII 2004.
8. *Peronospora farinosa* (Fr.) Fr. on *Chenopodium album* L., 2 VII 2004.

Kingdom Fungi

Phylum Ascomycota

Class Ascomycetes

Subclass Dothideomycetidae

Order Dothideales

Family Botryosphaeriaceae

1. *Diplodia rosarum Fr.* on *Rosa canina* L., 10 IX 2002
2. *Guignardia aesculi* (Peck) V.B. Stewart f. c. *Phyllosticta aesculi* Ellis & G. Martin on *Aesculus hippocastanum* L., 24 X 2001, 17 VII 2004.
3. *Phyllosticta aceris* Sacc. on *Acer campestre* L., 23 VIII 2002
4. *Phyllosticta setariae* Ferraris on *Setaria pumila* (Poir.) Schult., 25 VIII 2001.

Order Capnodiales

Family Capnodiaceae

5. *Capnodium salicinum* (Alb. et Schw.) Mont., f. c. *Fumago vagans* Pers., on *Larix decidua* Mill., 4 IX 2001.

Order Mycosphaerellales

Family Mycosphaerellaceae

6. *Mycosphaerella cerasella* Aderh., f. c. *Cercospora circumscissa* Sacc. on *Prunus avium* L., 17 VII 2004.
7. *Mycosphaerella microsora* Syd & P. Syd., f. c. *Cercospora microsora* Sacc.
on *Tilia cordata* Sacc., 25 VII 2001;
on *Tilia plathyphillos* Scop., 25 VII 2001;
on *Tilia tomentosa* , 31 VIII 2001.
8. *Mycosphaerella mori* (Fuckel) F.A. Wolf f.c. *Cylindrosporium mori* (Lév.) Berl. on *Morus alba* L., 17 VII 2004.
9. *Mycosphaerella populi* (Auersw.) J. Schröt. on *Populus alba* L., 31 VIII 2001.
10. *Mycosphaerella podagrariae* (Fr.) Petr. f.c. *Septoria podagrariae* Lasch on *Aegopodium podagraria* L., 2 VII 2004.
11. *Mycosphaerella pyri* (Auersw.) Boerema, f. c. *Septoria piricola* Desm on *Pyrus communis* L., P.10 J, 31 VIII 2001; on *Pyrus pyraster* Burgsd., 31 VIII 2001.
12. *Mycosphaerella ulmi* Kleb. f. c. *Cylindrosporium ulmi* (Fr.) on *Ulmus minor* Mill., 4 IX 2001.
13. *Ramularia sambucina* Sacc. on *Sambucus nigra* L., 2 VII 2004.
14. *Septoria acerella* Sacc. on *Acer campestre* L., 2 VII 2004.
15. *Septoria apatela* All et Magn.on *Acer campestre* L., 4 X 2001, 26 IV 2002.
16. *Septoria betulae* (Lib.) West. on *Betula pendula* Roth., 24 VIII 2001; on *Betula pendula* Roth. 'Youngii', 24 VIII 2001.
17. *Septoria clematidis* Pandotra & K.S.M. Sastry on *Clematis vitalba* L., 31 VIII 2004.
18. *Septoria chelidonii* Desm. on *Chelidonium majus* L., 4 X 2001.
19. *Septoria centaureicola* Brun. on *Centaurea scabiosa* L., 31 VIII 2001.
20. *Septoria convolvuli* Desm. on *Convolvulus arvensis* L., 24 VIII 2001.
21. *Septoria cornicola* Desm. on *Cornus sanguinea* L., 24 VIII 2001.
22. *Septoria salicis* Westend. & J. Kickx f on *Salix babilonica* L, 31 VIII 2001.

Order Myrangiales

Family Elsinoaceae

23. *Elsinoë rosarum* Jenkins & Bitanc.
on *Rosa* 'White Dorothy Perkins' (Kl. Cant., 1908), 19 XII 2000;
on *Rosa* 'Paprica' (Tantau, 1958), 30 VII 2001;
on *Rosa* 'Granate' (Min. Dat., 1947), 30 VII 2001.

Order Pleosporales

Family Cucurbitariaceae

24. *Cucurbitaria berberidis* (Pers.) Grev. (1821) on **Berberis hookerii* Lem, 25 X 2004, 18 XI 2005.

Family Leptosphaeriaceae

25. *Coniothyrium concentricum* (Desm.) Sacc. on *Yucca filamentosa* L., 8 VIII 2003.

Family Pleospraceae

26. *Stemphylium sarcinaeforme* (Cavara) Wiltshire on *Trifolium pratense* L., 24 VIII 2001.

27. *Alternaria alternata* (Fr.) Keissler on *Sambucus nigra* L., 24 VIII 2001.
Family Incertae sedis
28. *Camarosporium coluteae* (Peck & Cooke) Sacc on *Colutea orientalis* L., 17 VII 2004.
Family Venturiaceae
29. *Venturia inaequalis* (Cooke) Aderh. on *Malus pumila* Mill., 10 VI 1999, 20 VIII 2000, 31 VIII 2001.
30. *Venturia macularis* (Fr.) Müller et Arx on *Populus alba* L., 31 VIII 2001.
31. *Venturia pyrina* Aderh. on *Pyrus pyraster* L., 25 VII 2001.
Subclass Incertae sedis
Order Incertae sedis
Family Incertae sedis
32. *Sphaeropsis sapinea* (Fr.) Dyko & B. Sutton on *Pinus sylvestris* L., 14 V 2002, 24 IV 2004.
33. *Trichothecium candidum* Corda on *Robinia pseudacacia* L, 7 VIII 2003.
Subclass Erysiphomycetidae
Order Erysiphales
Family Erysiphaceae
34. *Erysiphe cichoracearum* Jacz. on *Taraxacum officinale* Weber., 31 VIII 2001;7 VIII 2003; 8 VIII 2003, 27 VII 2004.
35. *Erysiphe convolvuli* DC. on *Convolvulus arvensis* L., 24 VIII 2001.
36. *Erysiphe depressa* (Wallr.) Schltdl on *Arctium lappa* L., 31 VIII 2001, 7 VIII 2003, 8 VIII 2003, 27 VII 2004.
37. *Erysiphe heraclei* DC. on *Heracleum sphondylium* L., 31 VIII 2001, 27 VII 2004.
38. *Erysiphe hyperici* (Wallr.) S. Blumer on *Hypericum perforatum* L., 4 IX 2001.
39. *Erysiphe euonymi* DC. on *Euonymus europaeus* L., 27 VII 2004.
40. *Erysiphe betae* (Vaňha) Weltzien on *Polygonum aviculare* L., 25 VIII 2001.
41. *Erysiphe biocellata* Ehrenb. on *Salvia verticilata* L., 24 VIII 2001.
42. *Erysiphe sordida* Junell on *Plantago major* L., 24 VIII 2001, on *Plantago media* L., 11 XI 2004.
43. *Erysiphe syringae* Schwein., on *Syringa vulgaris L.*, 8 VIII 2004.
44. *Golovinomyces cynoglossi* (Wallr.) V.P. Heluta on *Symphythum officinale* L., 4 IX 2001.
45. *Neoerysiphe galeopsidis* (DC.) U. Braun on *Ballota nigra* L., 31 VIII 2001, on *Stachys sylvatica* L., 31 VIII 2001; on *Phlomis tuberosa* L., 31 VIII 2001; on *Lamium album* L., 4 X 2001, 1 IX 2004.
46. *Microsphaera alphitoides* Griff. et Maubl.
on *Quercus robur* L., 31 VIII 2001;
on **Quercus robur* L. 'Stenocarpa' , 1 IX 2004;
on **Quercus robur* L. subsp. *brutia* (Ten.) O. Schwarz, 1 IX 2004;
on *Quercus cerris* L., 1 IX 2004;
on *Quercus castaneifolia* C. A. Mey, 1 IX 2004;
on *Quercus robur* L '*Fastigiata*', 1 IX 2004, 1 IX 2004;
47. *Microsphaera berberidis* (DC.) Lév
on *Berberis vulgaris* L., P.6, 4 IX 2001;
on **Berberis Poitrettii* Schn., 18 XI 2004;
on **Berberis aggregata* Schneid., 18 XI 2004.
48. *Microsphaera trifolii* (Grev.) U. Braun on *Trifolium pratense* L., 24 VIII 2001.
49. *Podosphaera leucotricha (Ellis & Everh.) E.S. Salmon* on *Pyrus nivalis* Jacq. , 24 VIII 2001.
50. *Podosphaera pannosa* (Wallr.) de Bary on *Rosa* 'Siren' (Kordes, 1953), 19 XII 2000.
51. *Podosphaera xanthii* (Castagne) U. Braun & Shishkoff on *Physalis alkekengi* L., 24 X 2001.
52. *Phyllactinia guttata* (Wallr. ex Fr.) Lév. on *Staphylea pinnata* L., P.11, 4 IX , 24 X 2001.
53. *Sawadaea bicornis* (Wallr.) Homma on *Acer campestre* L., 4 IX 200.
54. *Sawadaea tulasnei* (Fuckel) Homma on *Acer pseudoplatanus* L., 6 XI 2004.
55. *Uncinula clandestina* (Biv.) J. Schröt. on *Ulmus minor* Mill., 12 VIII 2003.
Subclass Leotiomycetidae
Order Helotiales
Family Dermateaceae
56. *Blumeriella jaapii* (Rehm) v. Arx on *Prunus avium* L., 17 VII 2003.
57 *Diplocarpon rosae* Wolf.
on *Rosa* 'Elysium' (Kordes, 1961), 19 XII 2000;
on *Rosa* 'Frensham' (Norman Harknes, 1946), 19 XII 2000;
on *Rosa* 'Floradora' (Tantau, 1944), 19 XII 2000;
on *Rosa* 'Insel Mainau' (R. Kordes, 1959), 19 XII 2000;
on *Rosa* 'Lavender Girl' (F. Meilland, 1958) , 19 XII 2000 9 XI 2005;
on *Rosa* 'Luchian' (St. Wagner, 1970), 19 XII 2000;
on *Rosa* 'Olala' (Tantau , 1956), 19 XII 2000, 9 XI 2005;
on *Rosa* 'Märchenland' (Tantau, 1951), 19 XII 2000;
on *Rosa* 'Spartan' (Boerner, 1955), 19 XII 2000;
on *Rosa* 'Signalfeuer' (Tantau, 1959), 19 XII 2000, 9 XI 2005;
on *Rosa* 'Swantje' (Tantau, 1936), 19 XII 2000, 9 XI 2005;
on *Rosa* 'The Quen Elisabeth' (Lamerts, 1954), 19 XII 2000;
on *Rosa* 'Denisse Cassegrin' (Grandes Reseraises, 1922), 19 XII 2000;
on *Rosa* 'Orange triumph' (Kordes, 1937), 19 XII 2000;
on *Rosa* 'Paprica' (Tantau, 1958), 19 XII 2000;
on *Rosa.* 'Tantau 's Überraschung' (Math Tantau, 1951), 19 XII 2000;
on *Rosa* 'Zizi' (Delbad Chaboert Mobert, 1963), 19 XII 2000;
on *Rosa* 'Admiration', (S. Mac. Gredy), 1922, 30 VII 2001;
on *Rosa* 'Anne Letts' (G. F. Letts, 1953), 19 XII 2000;
on *Rosa* 'Brazier' (Mc. Gredy, 1966), 19 XII 2000;
on *Rosa* 'Charles Mallerin' (Meilland, 1951), 19 XII 2000;
on *Rosa* 'Diamond Jubilée' (Boerner, 1947), 19 XII 2000;
on *Rosa* 'Dame de Coeur' (Lens, 1958), 19 XII 2000;
on *Rosa* 'Emeraude d' Or' (Delbard-Chabert, 1965), 12 XII 2000;
on *Rosa* 'Fontanelle' (F.G. Mill, Co., 1927), 19 XII 2000; colab.
on *Rosa* 'Frankufurt am Main'(Boerner, 1960), 19 XII 2000;

on *Rosa* ‘Granate’ (Min. Dat., 1947), 19 XII 2000;
on *Rosa* ‘Gerda Henkel’ (Math. Tantau, 1964), 19 XII 2000;
on *Rosa* ‘Interflora’ (Meilland, 1968), 19 XII 2000;
on *Rosa* ‘Kordes Perfecta’ (Kordes, 1957), 19 XII 2000;
on *Rosa* ‘La Rose Tatouée ’ (Gaujard, 1956), 19 XII 2000;
on *Rosa* ‘Matterhon’ (D. L. Armstrong and Swimm, 1965), 12 XII 2000, 19 XII 2000, 9 XI 2005;
on *Rosa* ‘M-me René Kory’ (F. Meilland, 1955), 12 XII 2000, 19 XII 2000;
on *Rosa* ‘Mexicana’ (Boerner, 1966), 19 XII 2000;
on *Rosa* ‘Sir Wiston Churchill’ (D. Dikson), 1955, 19 XII 2000;
on *Rosa* ‘Tiffani’ (Lindquist, 1954), 19 XII 2000;
on *Rosa* ‘Versaille’ (Delbard-Chabert, 1967), 19 XII 2000;
on *Rosa* ‘Casino’ (S. M. C. Gredy, 1963), 19 XII 2000;
on *Rosa* ‘White Dorothy Perkins’ (Kl. Cant, 1908), 19 XII 2000;
Family Sclerotiniaceae

58 *Monilinia fructigena* Honey
on *Malus pumila* Mill., P. 12, 20 VIII 2000, 12 VII 2001, 31 VIII 2001; 7 VIII 2003; 8 VIII 2003; 11 X 2003; 27 VII 2004; 8 VIII 2004, 2 VIII 2005; 8 XI 2005; 18 XI 2005;
on *Chaenomeles japonica* (Thumb) Lindl, 1 IX 2003;
on **Chaenomeles* ‘Crimson Gold’ (Clarke, 1939), 1 IX 2003;
on *Chaenomeles lagenaria* Koidz, 1 IX 2003;
on **Chaenomeles cathayensis* (Hemsl.) Schneider, 1 IX 2003;
on *Cornus mas* L., 1 IX 2003.
Order Rhytismatales
Family Rhytismataceae

59 *Rhytisma acerinum* (Pers.) Fr.
f. c. *Melasmia acerina* Lév.
on *Acer platanoides* L., 23 IX 1998, 9.IX.1999, 20 VIII 2000, 31 VIII 2001, 24 X 2001, 31 X 2001, 8 VIII 2004
on *Acer campestre* L. 23 IX 1998, 9.IX.1999, 20 VIII 2000., 31 VIII 2001, 24 X 2001, 8 VIII 2004;
on *Acer pseudoplatanus*, 8 VIII 2004.

60 *Lophodermium pinastri* (Schrad.) Chev. f. c. *Leptostroma pinastri* Desm. on *Pinus sylvestris* L.
Subclass Sordariomycetidae
Order Diaporthales
Family Gnomoniaceae

61.*Gnomonia juglandis* (DC.)Trav. on *Juglans regia* L., P.7, 12 VII 2000; 7 VIII 2003, 8 VIII 2003, 27 VII 2004, 8 VIII 2004, 2 VIII 2005, 8 XI 2005,18 XI 2005.
Order Hypocreales
Family Nectriaceae

62. *Nectria cinnabarina* (Tode) Fr. on *Sambucus nigra* L., 4 IX 1999, 10 IX 2000, 12 XII 2000, 19 VII 2001, 26 IV 2002, 20 VIII 2002, 18 XI 2004, 2 VIII 2005
Order Phyllachorales
Family Phyllachoraceae

63 *Polystigma rubrum* (Pers.) St. Am. on *Prunus domestica* L., 12 VII 2000, 25 VII 2001.
Order Xylariales
Family Amphisphaeriaceae

64.*Pestalotiopsis funerea* (Desm.) Steyaert
on **Chameaciparis pisifera* S. et Z., 17 VII 2002;
on *Juniperus chinensis* L. ‘Piramidalis’, 4 X 2001;
on *Juniperus chinensis* L. ‘Leeana’ , 4 X 2001;
on *Juniperus rigida* S. et. Z., 4 X 2001;
on *Thuja orientalis* L., 17 VII 2002;
on *Thuja plicata* D. Don, 17 VII 2002;
on **Thuja orientalis* L. ‘Stricta’ Loud, 17 VII 2002;
on **Thuja orientalis* L. ‘Szemesii’, 17 VII 2002;
on **Thuja orientalis* L. ‘Elegantissima’; 17 VII 2002,
on **Thuja orientalis* L. ‘Rectispina’ 17 VII 2002;

Class Urediniomycetes
Subclass Incertae sedis
Order Uredinales
Family Coleosporaceae

1. *Coleosporium tussilaginis (Pers.) Lév.,* (II) on *Melampyrum bihariense* Kern., 31 VIII 2001.

Fam Melampsoraceae

2. *Melampsora euphorbiae* (C. Schub.) Castagne (I, II), on *Euphorbia cyparissias* L., 25 VIII 2001.
3. *Melampsora epitea* var. *epitea* Thüm. (II), on *Salix caprea* L., 19 VI 2001, 30 VII 2001.
4. *Melampsora populnea* (Pers.) P. Karst. (II, III) on *Populus alba* L., 31 VIII 2001.

Family Phragmidiaceae

5. *Phragmidium mucronatum* (Pers.) Schltdl. (II, III)
on *Rosa canina* L., 30 VIII 2000, 31 VIII 2001;
on *Rosa* ‘Allgold’ (Le Grice, 1956), 12 XII 2000;
on *Rosa* ‘Westminster’ (H. Robison, 1960), 12 XII 2000;
on **Rosa* ‘Orange triumph’ (Kordes, 1937), 12 XII 2000;
on **Rosa* ‘Soeur Thérése’ (F. Gillot 1930), 18 XI 2004;
on **Rosa* ‘First Lady’, 18 XI 2004;
on *Rosa* ‘The Quen Elisabeth’ (Lamerts, 1954), 18 XI 2004.
6. *Phragmidium potentillae* (Pers.) Karst. (II, III) on *Potentilla argentea* L., 25 VIII 2001.
7. *Phragmidium bulbosum,* (III) on *Rubus caesius* L., 25 VIII 2000.

Family Pucciniaceae

8. *Cumminsiella mirabilissima* (Peck) Nannf. (II, III) on *Mahonia aquifolium* (Pursch.) Nutt., 30 VIII 2000, 13 IV 2002.
9. *Gymnosporangium sabinae* (Dicks.) G. Winter (0, I),
on *Pyrus pyraster* Burgsd, 31 VIII 2001;
on *Pyrus amygdaliformis Will.*, 31 VIII 2001.
10. *Puccinia asarina* Kunze, (III) on *Asarum europaeum* L, 2 V 2005.
11. *Puccinia aegopodii* (Schumach.) Link, (III) on *Aegopodium podagraria* L., 2 VII 2004.
12. *Puccinia agropyri* Ellis & Everh. (0, I) on *Clematis vitalba* L.,2 VII 2004.
13. *Puccinia brachypodii* var. *brachypodii* G.H. Otth (II, III) on *Brachypodium sylvaticum* (Huds.) P.Beauv
14. *Puccinia brachypodii var. arrhenatheri* (Kleb.) Cummins & H.C. Greene, (II) on *Arrhenatherum elatius* (L.) P.Beauv. ex J.Presl & C.Presl

15. *Puccinia bardanae* (Wallr.) Corda (II, III) on *Arctium tomentosum* Miller., P.6, 4 IX 2001.

16. *Puccinia calcitrapae* DC. (II, III) on *Carduus crispus* L., P.11, 4 IX 2001.

17. *Puccinia carthami* Corda (II, III) on *Centaurea phrygia* L., 4 X, 1998, 24 VIII 2001.

18. *Puccinia cirsii* Lasch (II, III) on *Cirsium canum* All., 24 VIII 2001.

19. *Puccinia convolvuli* (Pers.) Castagne (II, III) on *Calystegia sepium* (L.) R. Br, 31 VIII 2001, 2 VII 2004; 2 VII 2004.

20. *Puccinia lapsanae* Fuckel (III) on *Lapsana communis* L, 2 VII 2004.

21. *Puccinia phragmitis* (Schum.) Körn. (III) on *Phragmites australis* (Cav.) Trin. ex Steud., 12 XI 1997; 19 IV 2002.

22. *Puccinia menthae* Pers. (I, II) on *Mentha longifolia* L. Nath, 25 VIII 2001.

23. *Puccinia singularis* Magnus (III) on *Anemone ranunculoides* L., 13 IV 2002.

24. *Uromyces dactylidis* G.H. Otth, (II, III) on *Dactylis glomerata* L., 27 VII 2004.

25. *Uromyces ficariae* Jahrb. Ver. Nat (II+III), on *Ranunculus ficaria* L., 24 IV 2004.

26. *Uromyces pisi-sativi* (Pers.) Liro (II, III) on *Astragalus glycyphyllos* L., 31 VIII 2001.

27. *Uromyces polygoni-avicularis (*Pers.) P. Karst. (II, III) on *Polygonum aviculare*, 25 VIII 2001.

28. *Uromyces trifolii* (R. Hedw.) Lév. (II), on *Trifolium pratense* L., 31 VIII 2001.

Family Uropyxidaceae

29. *Ochropsora ariae* (Fuckel) Ramsb. (O, I) on *Anemone ranunculoides* L., 13 IV 2002; 19 IV 2002.

30. *Tranzschelia pruni-spinosae* (Pers.) Dietel. (0+I) on *Amemone ranunculoides* L., 5 III 2000, 20 III 2001, 13 IV 2001, 9 IV 2002;
(II+III) on *Prunus domestica* L., 25 VII 2001.

Conclusions

The 102 species of micromycetes identified belong to: 2 kingdom, 3 phylums, 3 classes (8 - Oomycetes, 63 - Ascomycetes and 30 - Basidiomycetes), 13 orders, 23 families and 47 genera.

The diversity of the stationary conditions and the varied nature of the substrate from which mycological material was taken, all of them contributed to the biodiversity of the species.

Rezumat

În lucrare, sunt prezentate 102 specii de micromicete, colectate din Arboretumul Hemeiuş în perioda 1998 – 2005. Speciile se încadrează în 2 regnuri, 3 încrengături, 3 clase, 13 ordine, 23 de familii şi 47 de genuri. Dintre acestea, 7 specii de micromicete le semnalăm pe 15 plante-gazdă noi pentru România.

Materialul micologic a fost introdus în herbarul micologic din cadrul Muzeului de Ştiinţele Naturii "Ion Borcea" din Bacău.

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References

1. BRAUN UWE, 1987 – A *monograph of the Erysiphales (powdery mildews)*. Beih. Nova Hedwigia, Heft 89, Berlin, Stuttgart, J. Cramer, 700 pp.
2. CIOCÎRLAN V., 1990 – *Flora ilustrată a României*. Vol. I, II, Ed. Ceres, Bucureşti.
3. CONSTANTINESCU O., 1974 - *Metode şi tehnici în micologie*. Ed. Ceres, Bucureşti, 261 pp.
4. MIHALACHE A., 1988 - *Monografia Arboretumului Hemeiuş*. Centrul de Material Didactic şi Propagandă Agricolă, Bucureşti, 245 pp.
5. RĂDULESCU E., NEGRU AL., DOCEA E., 1973 – *Septoriozele din România*. Ed. Academiei R. P. R., Bucureşti, 325 pp.
6. SANDU - VILLE C., 1967 - *Ciupercile Erysiphaceae din România - studiu monografic*. Ed. Academiei R. S. Române, Bucureşti, 358 pp.
7. SANDU-VILLE C., 1971 - *Ciupercile Pyrenomycetes - Sphaeriales din România*. Ed. Academiei R. S. Române, Bucureşti, 409 pp.
8. SĂVULESCU TR., 1953 - *Monografia Uredinalelor din Republica Populară Română*. Vol. I-II, Ed. Academiei R. P. Române, Bucureşti, 1166 pp.
9. SĂVULESCU TR., SĂVULESCU O., 1964 - *Peronosporaceele din Republica Populară Română*, Acta Bot. Horti. Bucurestiensis, Bucureşti, 146 pp.
10. SIMIONESCU A. şi colab., 2001 - *Starea de sănătate a pădurilor din România în intervalul 1986-2000*. Regia Naţională a Pădurilor, Ed. Muşatinii, Suceava:164, 174, 186, 585, 600, 612, 618.
11. TĂNASE C., 2002 - *Micologie, Manual de lucrări practice*. Ed. Universităţii "Alexandru Ioan Cuza", Iaşi, 227 pp.
12. ***, http://rbg-web2.rbge.org.uk/FE/fe.html
13. *** , http://www.indexfungorum.org/

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE BIODIVERSITY OF THE MACROMYCETES IN THE HEMEIUŞ ARBORETUM, BACĂU COUNTY

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CĂTĂLIN TĂNASE**

ABSTRACT

PAVEL C. O., TĂNASE C., 2006 - The biodiversity of the macromycetes in the Hemeius Arboretum, Bacău county. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 59-68.

This paper presents the results of the taxonomic and ecological researches on the macromycetes from Hemeiuş Arboretum, in 1997-2005. The 236 species of macromycetes identified belong to: 2 phylums, 2 classes (22 Ascomycetes and 214 Basidiomycetes), 14 orders, 51 families, and 112 genera. The macromycetes species belong to 9 biological forms and 9 ecological categories. The bioforms spectrum is dominated by mycetogeophytes – 57 % and the ecological spectrum is dominated by saprotrophic species – 146 (61 %). From the nutritive value perspective 153 species are not edible, among these 67 edible species.

Key words: macromycetes, bioforms, ecological cetegory, Hemeiuş, Bacău

Introduction

The Hemeiuş Arboretum was founded at the end of the 19th century, first having an ornamental and entertaining aim. It is situated in the area of Hemeiuş village, 10 km away from Bacău.

From the geographical point of view, it is situated at the west border of the Moldavian Plateau, at the collision with the Moldavian Subcarpathians, in a Bistriţa river meadow, on a terrace of accumulative origin, having geographical coordinates: 46° 37' 0" N latitude, 26° 51' 0" E longitude, altitude of 157 m.

The climate is continental, characteristic to the hilly land with wide depressions. In summer, there are long periods of drought and during the winter there are cold currents from the Bistriţa river meadow, fact that creates a specific more arid microclimate. The mean annual temperature is 9,2° C and the mean annual precipitation is 544 mm.

The Hemeiuş Arboretum lies on a 49,5 ha containing 10 ha of larch trees and pine plantations, 2 ha of clonal collections with species of local and exotic spruce fir, 20 ha of riparian mixed forest, 15 ha of dendrological collection and glades, 1,5 ha of nursery and 1 ha of administrative land (9).

From the specific literature concerning the scientific reservations of Hemeiuş, one can see that the flora of this field contains almost 1700 taxa of which the dendrological collections contains almost 1060 taxa (187 of coniferous species and 873 of deciduous species), the roses collection has 210 taxa and the rest is represented by the spontaneous flora.

The arborescent layer is dominated by *Quercus robur, Ulmus minor,* and also we can find the species: *Carpinus betulus, Fraxinus excelsior, Tilia tomentosa, T. cordata, Acer platanoides, A. campestre, Populus alba, Alnus glutinosa, Prunus avium.*

The research had as a goal the cognition of the diversity of the macromycetes in the area which was not studied from the mycological point of view. The researches were effectuated between 1997 and 2005 on the diversity of the macromycetes in Hemeiuş Arboretum.

From the phytocoenological studies realized in the Hemeiuş Arboretum, I established that there is a number of 15 vegetal associations and the largest

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surface is occupied by Quercetum robori-petraeae Borza 59 (2).

The diversity of the stationary conditions and the varied nature of the substrate from which mycological material was taken, all of them contributed to the biodiversity of the species.

Material and method

For the determination, one realized microscopic preparations which were put in Amann lactofenol and which were colored in cotton blue. The examinations were effectuated at the Olympus SZ61 stereomicroscope and at the Olympus CX 31 microscope.

The collected material was determined using the mycological literature. The classification and the nomenclature of the species was updated according to Index Fungorum (Kirk and his co-workers) (11).

The classification of the macromycetes depending on the bioform (life form), the food value, the toxicity, was made after G. Sălăgeanu, 1985 (10).

During the period from 1997 to 2005 examinations were made upon the macromycetes, from January to December in the following vegetal formations: meadow, riparian mixed forest, plantations and collection of larch trees, of pine trees, of spruce trees, of fir trees.

The mycological material was preserved and introduced in the collection of macromycetes of the Museum of Natural Sciences from Bacău.

Results and discussion

The researches effectuated between the years 1997 and 2005 contribute at the cognition of the biodiversity of the macromycetes in Hemeiuş Arboretum.

The identified macromycetes, in number of 236 are from the Fungi kingdom and they belong to two phylums Ascomycota and Basidiomycota, 2 classes, 13 orders and 51 families, 112 genera. A taxonomically arranged list of all the species collected is reported in a Tab. 1.

The macromycetes from Ascomycetes class are in a small number: 22 species, belonging to 17 genera, 8 families, 3 orders and 3 subclasses.

The macromycetes from Basidiomycota class have the highest prevalence of 90,67 % (214) and they belong to 95 genera, 43 families, 10 orders.

From the numerical analysis, it results that the predominant species from the orders: Agaricales – 125 species, Polyporales -28 species, Russulales – 27 species (fig. 1).

The families that are representative from the numerical point of view: Tricholomataceae - 31 species, Russulaceae - 21 species, Agaricaceae - 21 species, Marasmiaceae - 19 species, Polyporaceae -16 species.

The genera which have a significant prevalence: *Russula* – 21 species, *Mycena* -10 species, *Clitocybe* – 7 species.

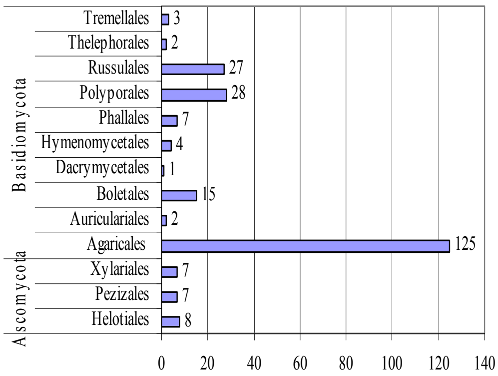

Fig. 1 - The number of species on orders

The macromycetes species belong to 9 biological forms and 9 ecological categories (Table 1, fig. 2, 3). From the biological forms the prevalent belong to mycetogeophytes – 57 %, followed by the mycetoepiphytes – 24%. From the macromycetes, prevalent from the biodiversity and quantity pointy of view there are the mycetogeophytes: Gs -75 species, Gm – 55 species.

The ecological spectrum is dominated by saprotrophic species – 146 (61 %), followed by mycorhizes species -55 (23 %). From the ecologic analysis of the categories (fig. 3) one can see that the saprotrophic species on soil or humus – 59 (25%), saprotrophic species on dead wood -58 (24,57).

The species that are frequent in the Hemeiuş Arboretum: *Agaricus silvicola* (Vitt.) Peck, *Agaricus xanthodermus* Genev., *Armillaria mellea* (Vahl) P. Kumm., *Bjerkandera adusta* (Willd.) P. Karst., *Lepista inversa* (Scop.) Pat., *Coprinus disseminatus* (Pers.) Gray, *Gymnopus dryophilus* (Bull.) Murrill, *Hypholoma fasciculare* (Huds.) P. Kumm., *Inocybe rimosa* (Bull.) P. Kumm., *Macrolepiota procera* (Scop.) Singer, *Mycena galericulata* (Scop.) Gray, *Mycena pura* (Pers.) P. Kumm., *Paxillus involutus* (Batsch) Fr., *Stereum hirsutum* (Willd.) Pers., *Trametes versicolor* (L.) Lloyd., *Trametes gibbosa* (Pers.) Fr.

From the economic importance point of view the most numerous are the inedible species – 153 (65%), followed by the edible species – 67 (28 %) and toxic 17 (7 %). Of the edible fungi, 41 species have a low food value (X), 16 have a medium food value (XX) and 10 species have a very high food value (XXX).

The toxic species belong to 3 groups: 7 species which produce gastro – intestinal intoxication (†), 6 species which produce intoxication of the nervous system (††), and 4 species which cause lethal intoxication († † †).

Among rare species, we mention: *Boletus queletii* Schulzer, *Calocybe ionides* (Bull.) Donk, *Lepiota kuehneri* Huijsman ex Hora, *Stropharia albocyanea* (Fr.) Quél., and *Volvariella hypopythis* (Fr.) M.M. Moser.

Tab. 1 - Systematic conspectus of the macromycetes from Hemeiuş Arboretum

Species Kingdom FUNGI	**Biologic form**	**Ecologica category**	**Food values/ Toxicity/ Inedible**	**1**	**2**	**3**	**4**	**5**	**6**
Phylum ASCOMYCOTA, Class Ascomycetes Subclass Leotiomycetidae Order Helotiales Family Helotiaceae									
Ascocoryne sarcoides (Jacq.) J.W. Groves & D.E. Wi	**EPx**	**Sl**		-	+	-	-	-	-
Bisporella citrina (Batsch) Korf & Carpenter	**EPx**	**Sl**		-	+	-	-	-	-
Chlorociboria aeruginascens (Nyl.) Kanouse Ramamurthi, Korf & L.R. Batra	**EPx**	**Sl**		-	+	-	-	-	-
Hymenoscyphus fructigenus (Bull.) Fr.	**EPx**	**Sl**		-	+	-	-	-	-
Hymenoscyphus herbarum (Pers.) Dennis	**Gs**	**Sf**		-	+	-	-	-	-
Heyderia abietis (Fr.) Link	**Gs**	**Sf**		-	-	-	+	-	-
Family Rustroemiaceae									
Rutstroemia bolaris (Batsch) Rehm	**EPx**	**Sl**		-	+	-	-	-	-
Family Sclerotiniaceae									
Encoelia fascicularis (Alb. & Schwein.) P. Karst.	**EPx**	**Sl**		-	+	-	-	-	-
Subclass Pezizomycetidae Order Pezizales Family Helvellaceae									
Helvella crispa (Scop.) Fr	**Gs**	**St**		-	+	-	-	-	-
Helvella lacunosa Afzel.	**Gs-EPx**	**Sh-Sl**	**X**	-	+	-	-	-	-
Leptopodia elastica Bull. (Boud.)	**Gs**	**St**		-	+	-	-	-	-
Family Pezizaceae									
Peziza badia Pers.	**Gs**	**St**	**X**	-	+	+	+	-	-
Family Pyronemataceae									
Aleuria aurantia (Pers.) Fuckel	**Gs**	**St**	**X**	-	+	-	-	-	-
Humaria hemisphaerica (F.H. Wigg.) Fuckel	**Gs**	**St**		-	+	-	-	-	-
Family Sarcoscyphaceae									
Sarcoscypha coccinea (Jacq.) Sacc.	**EPx**	**Sl**		-	+	-	-	-	-
Subclass Sordariomycetidae Order Xylariales Family Xylariaceae									
Daldinia concentrica (Bolton) Ces. & De Not	**EPx**	**Sl**		-	+	-	-	-	-
Xylaria hypoxylon (L.) Grev.	**EPx**	**Sl**		-	+	-	-	-	-
Xylaria polymorpha (Pers.) Grev	**EPx**	**Sl**		-	+	-	-	-	-
Hypoxylon fragiforme (Pers.) J. Kickx	**EPx**	**Sl**		-	+	-	-	-	-
Hypoxylon fuscum (Pers.) Fr	**EPx**	**Sl**		-	+	-	-	-	-
Hypoxylon variolosum (L.) Keissl	**EPx**	**Sl**		-	+	-	-	-	-
Kretzschmaria deusta (Hoffm.) P.M.D. Martin	**EPx**	**Sl**		-	+	+	+	-	-
Phylum Basidiomycota, Class Basidiomycetes Subclass Agaricomycetidae Order Agaricales Family Agaricaceae									
Agaricus arvensis Schaeff.	**Gs**	**St**	**XXX**	+	-	-	-	-	-
Agaricus moelleri Wasser	**Gs**	**St**	**X**	-	+	-	-	-	-
Agaricus semotus Fr.	**Gs**	**St**	**XX**	-	-	-	+	-	-
Agaricus silvaticus Schaeff.	**Gs**	**St**	**XX**	-	+	+	+	-	-

Agaricus silvicola (Vitt.) Peck	**Gs**	**St**	**XX**	-	+	+	+	-	-
Agaricus xanthodermus Genev.	**Gs**	**St**	†	-	+	-	-	-	-
Coprinus comatus (O.F. Müll.) Gray	**Th**	**St**	**XXX**	-	+	-	-	-	-
Coprinus disseminatus (Pers.) Gray	**Th**	**Sh-Sl**		-	+	+	-	-	-
Coprinus micaceus (Bull.) Fr.	**Th**	**Sh-Sl**		+	+	+	+	+	+
Cystolepiota hetieri (Boud.) Sing.	**Gs**	**St**		-	+	-	-	-	-
Lepiota aspera (Pers.) Quél	**Gs**	**St**		-	+	-	-	-	-
Lepiota cristata (Bolton) P. Kum	**Gs**	**St**		-	+	+	+	-	-
Lepiota echinacea J.E. Lange	**Gs**	**St**		-	+	-	-	-	-
Lepiota lilacea Bres.	**Gs**	**St**	†	+	+	-	-	-	-
Lepiota kuehneri Huijsman ex Hora	**Gs**	**St**		-	+	-	-	-	-
Leucoagaricus serenus (Fr.) Bon & Boiff.	**Gs**	**St**		-	+	-	-	-	-
Leucoagaricus leucothites (Vittad.) M.M. Moser ex B	**Gs**	**St**	**XX**	-	+	-	-	-	-
Macrolepiota procera (Scop.) Singer	**Gs**	**St**	**XXX**	-	+	+	+	+	+
Macrolepiota puellaris (Fr.) M.M. Moser	**Gs**	**St**		-	-	+	-	-	-
Macrolepiota rhacodes (Vittad.) Singer	**Gs**	**St**	**XXX**	-	+	+	+	+	+
Macrolepiota gracilenta (Krombh.) Wasser	**Gs**	**St**		-	+	-	-	-	-
Family Bolbitiaceae									
Agrocybe pediades (Fr.) Fayod	**Gs**	**St**	**X**	+	-	-	-	-	-
Panaeolus papilionaceus var. *papilionaceus* (Bull.) Q	**Th**	**Sc**		+	+	-	-	-	+
Panaeolus sphinctrinus (Fr.) Quél.	**Th**	**Sc**		+	+	+	+	+	+
Family Cortinariaceae									
Crepidotus cesatii (Rabenh.) Sacc.	**EPx**	**Sl**		-	+	-	-	-	-
Crepidotus variabilis (Pers.) P. Kumm	**EPx**	**Sl**		-	-	-	-	-	-
Galerina marginata (Batsch) Kühne	**EPx**	**Sl**		-	+	-	-	-	-
Gymnopilus spectabilis (Fr.) Singer	**EPx**	**Sl**		-	+	-	-	-	-
Inocybe asterospora Quél.	**Gm**	**M**	† †	-	-	-	+	-	-
Inocybe cookei Bres.	**Gm**	**M**	† †	-	-	-	+	-	-
Inocybe geophylla (Pers.) P. Kumm.	**Gm**	**M**		-	-	-	+	+	-
Inocybe nitidiuscula (Britzelm.) Lapl	**Gm**	**M**		-	-	+	-	+	-
Inocybe rimosa (Bull.) P. Kumm.	**Gm**	**M**	† †	-	+	+	+	+	-
Inocybe umbrina (Bres.) Sacc.	**Gm**	**M**	† †	-	-	+	-	-	-
Tubaria conspersa (Pers.) Fayod	**Gs**	**St**		-	+	-	-	-	-
Family Entolomataceae									
Clitopilus prunulus (Scop.) P. Kumm	**Gs**	**St**	**XXX**	-	+	-	-	-	-
Entoloma rodhopodium (Fr.) P. Kumm.	**Gs**	**St**		-	+	-	-	-	-
Entoloma lampropus (Fr.) Hesler	**Gs**	**St**		+		-	-	-	
Entoloma hirtipes (Schumach.) M.M. Moser	**Gs**	**St**		-	+	-	-	-	-
Family Fistulinaceae									
Fistulina hepatica (Schaeff.) With.	**Ex-EPx**	**SPl**	**X**	-	+	-	-	-	-
Family Hydnangiaceae									
Laccaria amethystina Cooke	**Gm**	**M**	**XX**	-	+	+	+	+	+
Laccaria laccata (Scop.) Fr.	**Gm**	**M**	**X**	-	+	-	-	-	-
Family Hygrophoraceae									
Hygrophorus leucophaeus (Scop.) Fr.	**Gm**	**M**		-	+	-	-	-	-
Family Lycoperdaceae					+			-	-
Bovista plumbea Pers.	**Gs**	**St**	**X**	+	+	-	-	-	-
Handkea excipuliformis (Scop.) Kreisel	**Gs**	**St**	**X**	+	+	-	-	-	-
Handkea utriformis (Bull.) Pers	**Gs**	**St**	**X**	+	-	-	-	-	-
Lycoperdon echinatum Pers	**Gs**	**St**		-	+	-	-	-	-
Lycoperdon perlatum Pers	**Gs**	**St**		-	+	+	+	+	+
Lycoperdon pyriforme Schaeff	**EPx**	**Sl**		-	+	-	-	-	-
Family Marasmiaceae									
Armillaria mellea (Vahl) P. Kumm.	**Ex-EPx**	**SPl**	**XX**	-	+	-	-	-	-
Armillaria cepistipes Velen.	**Ex-EPx**	**SPl**	**X**	-	+	-	-	-	-
Flammulina velutipes (Curtis) Singer	**Ex-EPx**	**SPl**	**X**	-	+	-	-	-	-

Marasmiellus candidus (Bolton) Singer	**EPx**	**Sl**		-	+	+	+	-	-
Marasmiellus ramealis (Bull.) Singer	**EPx**	**Sl**		-	+	+	+	-	+
Marasmius androsaceus (L.) Fr.	**Gs**	**Sf**		-	-	+	-	-	+
Marasmius epiphylus (Pers. Ex Fr.) Fr.	**Gs**	**Sf**		-	+	-	-	-	-
Marasmius cohaerens (Alb. & Schwein.) Cooke & Quél	**EPx**	**Sf-Sl**		-	+	-	-	-	-
Marasmius oreades (Bolton) Fr.	**Gp**	**St**	**XXX**	+	-	-	-	-	-
Marasmius rotula (Scop.) Fr.	**EPx-Gs**	**Sf-Sl**		-	+	-	-	-	-
Marasmius wynnei Berk. & Broom	**Gs**	**Sf**		-	-	+	+	+	+
Micromphale foetidum (Sowerby) Singer	**EPx**	**Sl**		-	+	-	-		-
Micromphale brassicolens var. brassicolens (Romagn.) P.D. Ortor	**Gs**	**Sf**		-	-	-	+	-	-
Rhodocollybia butyracea f. butyracea (Bull.) Lennox	**Gs**	**St**		-	-	+	-	-	-
Strobilurus esculentus (Wulfen) Singer	**Gs**	**Sl**		-	-	-	+	-	-
Strobilurus tenacellus (Pers.) Singer	**Gs**	**Sl**		-	-	-	-	+	-
Strobilurus stephanocystis (Kühner & Romagn. Ex Hora) Singer	**Gs**	**Sl**		-	-	-	-	+	-
Xerula radicata (Relhan) Dörfelt	**Gs-EPx**	**Sh-Sl**		-	+	-	-	-	-
Xerula longipes (P. Kumm.) Maire	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Family Nidulariaceae									
Crucibulum laeve (Huds.) Kambly	**EPx**	**Sl**		-	+	-	-	-	-
Cyathus striatus (Huds.) Willd	**EPx-Gs**	**Sf-Sl**		-	+	+	-	-	-
Family Pleurotaceae									-
Pleurotus cornucopiae (Paulet) Rolland	**Ex-EPx**	**SPl**	**XX**	-	+	-	-	-	-
Family Pluteaceae									
Amanita alba Pers	**Gm**	**M**	† † †	-	+	-	-	-	-
Amanita muscaria var. muscaria (L.) Lam	**Gm**	**M**	† †	-	-	-	-	+	-
Amanita pantherina Gonn. & Rabenh.	**Gm**	**M**	† †	-	-	-	-	+	-
Amanita phalloides (Vaill. ex Fr.) Link	**Gm**	**M**	† † †	-	-	+	+	-	-
Amanita rubescens var. *rubescens* Pers.	**Gm**	**M**	**XXX**	-	+	-	-	-	-
Amanita vaginata (Bull.) Lam.	**Gm**	**M**	†	-	-	-	-	+	-
Pluteus salicinus (Pers.) P. Kumm	**EPx**	**Sl**	**X**	-	+	-	-	-	-
Pluteus cervinus P. Kumm.	**EPx**	**Sl**	**X**	-	+	-	-	-	-
Pluteus petasatus (Fr.) Gillet	**EPx**	**Sl**	**X**	-	+	-	-	-	-
Volvariella hypopythis (Fr.) M.M. Moser	**Gs**	**St**		-	+	-	-	-	-
Family Psathyrellaceae									
Coprinopsis atramentaria (Bull.) Redhead, Vilgalys & Moncalvo	**Th**	**St**	†	+	+	-	-	-	-
Coprinellus domesticus (Bolton) Vilgalys, Hopple & Jacq. Johns	**Th**	Sl		-	+	-	-	-	-
Coprinopsis picacea (Bull.) Redhead, Vilgalys & Mo	**Th**	**St**		+	-	-	-	-	-
Parasola plicatilis (Curtis) Redhead, Vilgalys & Hop	**Th**	**St**		+	-	-	-	-	-
Psathyrella gracilis (Fr.) Quél.	**Gs**	**St**		-	+	-	-	-	-
Psathyrella leucotephra (Berk. & Broome.) P.D.Orto	**Gs**	**St**		+	-	-	-	-	-
Family Schizophyllaceae									
Schizophyllum commune Fr.	**Ex-EPx**	**SPl**		-	+	+	+	+	+
Family Strophariaceae									
Hypholoma capnoides (Fr.) P. Kumm.	**EPx**	**Sl**		-	-	+	+	-	-
Hypholoma fasciculare (Huds.) P. Kumm	**EPx**	**Sl**	+	-	+	+	+	+	-
Pholiota squarrosa (Weigel) P. Kumm.	**Ex**	**Pl**		-	+	-	-	-	-
Stropharia aeruginosa (Curtis) Quél.	**Gs**	**St**	**X**	-	+	+	+	+	+
Stropharia albocyanea (Fr.) Quél.	**Gs**	**St**	**X**	-	-	+	+	+	+
Stropharia semiglobata (Batsch. ex Fr.) Quél	**Gs**	**Sc**		+	-	-	-	-	-
Family Tricholomataceae									
Calocybe ionides (Bull.) Donk	**Gs**	**St**	**X**	-	+	-	-	-	-
Clitocybe alexandri (Gillet) Konrad	**Gs**	**St**	**XX**	-	-	-	-	+	-
Clitocybe candicans (Pers.) P. Kumm.	**Gs**	**Sf**	† † †	-	-	+	+	+	-
Clitocybe clavipes (Pers.) P. Kumm.	**Gs**	**Sf**	**X**	-	-	-	-	+	-
Clitocybe dealbata (Sowerby) Gillet	**Gs**	**St**	† † †	+	-	-	-	-	-
Clitocybe gibba (Pers.) P. Kumm	**Gs**	**Sf**	**X**	-	+	+	+	+	-
Clitocybe metachroa (Fr.) P. Kumm.	**Gs**	**St**		-	+	-	-	-	-

Clitocybe nebularis (Batsch) Quél.	**Gs**	**St**	†	-	+	-	-	+	-
Clitocybe odora (Bull.) P. Kumm	**Gs**	**Sf**	**X**	-	+	+	+	+	+
Clitocybe phaeophthalma (Pers.) Kuype	**Gs**	**Sf**		-	+	-	-	-	-
Gymnopus erythropus (Pers.) Antonín	**Gs**	**Sf**		-	-	+	+	+	+
Gymnopus dryophilus (Bull.) Murrill	**Gs**	**Sf**	**X**	-	+	+	+	+	+
Gymnopus fusipes (Bull.) Gray	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Gymnopus peronatus (Bolton) Antonín	**Gs**	**Sf**		-	+	+	+	+	+
Lepista inversa (Scop.) Pat.	**Gs**	**St**	**X**	-	-	+	+	+	+
Lepista nuda (Bull.) Cooke	**Gs**	**St**	**XXX**	-	+	-	-	-	-
Megacollybia platyphylla (Pers.) Kotl. & Pouzar	**EPx**	**Sl**	**X**	-	+	-	-	-	-
Melanoleuca grammopodia (Bull.) Murrill	**Gs**	**St**	**X**	-	+	-	-	-	-
Melanoleuca melaleuca (Pers.) Murrill	**Gs**	**St**	**X**	-	-	-	+	-	-
Mycena alcalina (Fr.) P. Kumm.	**EPx**	**Sl**		-	+	-	-	-	-
Mycena citrinella (Pers.) P. Kumm	**Gs-EPx**	**Sh-Sl**		-	-	-	+	-	-
Mycena epipterygia var. *epipterygia* (Scop.) Gray	**Gs**	**Sf**			+	+	+	+	+
Mycena flavoalba (Fr.) Quél.	**Gs**	**St**		-	+	-	-	-	-
Mycena galericulata (Scop.) Gray	**Ex-EPx**	**SPl**		-	+	-	-	-	+
Mycena inclinata (Fr.) Quél.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Mycena polygramma (Bull.) Gray	**Gs-EPx**	**Sh-Sl**		-	+	-	+	-	+
Mycena pura (Pers.) P. Kumm	**Gs**	**Sf**		-	+	+	+	+	+
Mycena rosea (Schumach.) Grambe	**Gs**	**Sf**		-	+	+	+	+	+
Mycena vitilis (Fr.) Quél.	**Gs**	**St**		-	+	-	-	+	+
Tricholoma myomyces (Pers.) J.E. Lange	**Gm**	**M**	**XX**	-	+	-	-	-	-
Tricholoma portentosum (Fr.) Quél	**Gm**	**M**	**XX**	-	-	-	+	-	-
Order Auriculariales									
Family Auriculariaceae									
Auricularia auricula-judae (Fr.) Quél.	**EPx**	**Sl**	**X**	-	+	-	-	-	-
Auricularia mesenterica (Dicks.) Pers.	**Ex- EPx**	**SPl**		-	+	-	-	-	-
Order Boletales									
Family Boletacea									
Boletus edulis Bull.	**Gm**	**M**	**XXX**	-	-	-	+	-	-
Boletus calopus Pers.	**Gm**	**M**		-	+	-	-	-	-
Boletus chrysenteron Bull.	**Gm**	**M**	**X**	-	+	+	+	+	+
Boletus lividus (Bull.) Fr.	**Gm**	**M**	**X**	-	+	-	-	-	-
Boletus ferrugineus Boud.	**Gm**	**M**	**X**	-	+	-	-	-	-
Boletus queletii Schulzer	**Gm**	**M**	**X**	-	-	+	-	+	-
Boletus radicans Pers.	**Gm**	**M**		-	+	-	-	-	-
Leccinum crocipodium (Letell.) Watling	**Gm**	**M**	**XX**	-	+	-	-	-	-
Family Coniophoraceae									
Coniophora puteana (Schumach.) P. Karst.	**EPx**	**Sl**		-	+	-	-	-	-
Family Gomphidiaceae									
Chroogomphus rutilus (Schaeff.) O.K. Mil	**Gm**	**M**	**X**	-	-	-	-	+	-
Gomphidius glutinosus (Schaeff.) Fr.	**Gm**	**M**	**XX**	-	-	-	-	+	-
Family Paxillaceae									
Gyrodon lividus (Bull.) Fr.	**Gm**	**M**	**X**	-	+	-	-	-	-
Paxillus filamentosus Fr.	**Gm**	**M**		-	+	-	-	-	-
Paxillus involutus (Batsch) Fr.	**Gm**	**M**		-	+	-	-	-	-
Family Suillaceae									
Suillus granulatus (L.) Snell	**Gm**	**M**	**XXX**	-	-	-	-	+	-
Order Dacrymycetales									
Family Dacrymycetaceae									
Calocera cornea	**EPx**	**Sl**		-	+	-	-	-	-
Order Hymenomycetales									
Family Hymenomycetaceae									
Hymenochaete rubiginosa (Dicks.) Lév	**EPX**	**Sl**		-	-	+	-	-	-
Phellinus igniarius (L.) Quél.	**Ex**	**Pl**		-	+	-	-	-	-

Phellinus robustus (Karst.) Bourd et Galz.	**Ex**	**Pl**		-	+	-	-	-	-
Family Schizoporaceae									
Hyphodontia arguta (Fr.) J. Erikss.	**EPx**	**Sl**		-	+	-	-	-	-
Hyphodontia quercina (Pers.) J. Erikss	**EPx**	**Sl**		-	+	-	-	-	-
Order Phallales									
Family Geastraceae									
Geastrum fimbriatum Fr	**Gs**	**St**		-	+	+	+	+	-
Geastrum striatum DC.	**Gs**	**St**		-	-	+	+	-	-
Family Gomphaceae									
Ramaria stricta (Pers.) Quél.	**EPx**	**Sl**		-	+	-	-	-	-
Ramaria apiculata (Fr.) Donk	**EPx**	**Sl**		-	-	+	+	-	-
Ramaria invalii (Cotton & Wakef.) Donk	**Gs**	St			+	-	-	-	-
Family Sclerodermataceae									
Scleroderma verrucosum (Bull.) Pers	**Gm**	**M**	†	-	+	-	-	-	-
Order Polyporales									
Family Corticiaceae									
Corticium croceum (Kunze) Bres.	**EPx**	**Sl**		-	+	-	-	-	-
Family Fomitopsidaceae									
Daedalea quercina (L.) Pers.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Fomitopsis pinicola (Sw.) P. Karst.	**Ex-EPx**	**SPl**		-	-	+	+	+	-
Family Ganodermataceae									
Ganoderma applanatum (Pers.) Pat.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Ganoderma lucidum (Curtis) P. Karst.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Family Gloeophyllaceae									
Gloeophyllum abietinum (Bull.) P. Karst.	**Ex-EPx**	**SPl**		-	-	-	+	-	-
Gloeophyllum odoratum (Wulfen) Imazeki	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Gloeophyllum sepiarium (Wulfen) P. Karst	**EPx**	**Sl**		-	-	-	+	-	-
FamilyHapalopilaceae									
Bjerkandera adusta (Willd.) P. Karst.	**EPx**	**Sl**		-	+	+	+	+	+
FamilyHyphodermataceae									
Hyphoderma puberum (Fr.) Wallr.	**EPx**	**Sl**		-	+	-	-	-	-
Family Meruliaceae									
Merulius corium (Pers.) Ginns	**EPX**	**Sl**		-	+	-	-	-	-
Merulius tremellosus Schrad	**Ex -EPx**	**SPl**			+	-	-	-	-
Family Polyporaceae									
Cerrena unicolor (Bull.) Murrill	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Daedaleopsis confragosa (Bolton) J. Schröt.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Fomes fomentarius (L.) J.J.Kickx	**Ex**	**Pl**		-	+	-		-	-
Laetiporus sulphureus (Bull.) Murrill	**Ex**	**Pl**	**X**	-	+	-	-	-	-
Lentinus cyathiformis (Schaeff.) Bres.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Lentinus strigosus (Schwein.) Fr.	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Polyporus arcularius (Batsch) Fr.	**EPx**	**Sl**		-	+	-	-	-	-
Polyporus brumalis (Pers.) Fr.	**EPx**	**Sl**		-	+	-	-	-	-
Polyporus squamosus (Huds.) Fr.	**Ex-EPx**	**SPl**	**X**	-	+	-	-	-	-
Polyporus varius (Pers.) Fr	**Ex-EPx**	**SPl**		-	+	-	-		-
Skeletocutis nivea (Jungh.) Jean Keller	**EPx**	**Sl**		-	+	-	-	-	-
Trametes gibbosa (Pers.) Fr.	**EPx**	**Sl**		-	+	-	-	-	-
Trametes hirsuta (Wulfen) Pilá	**EPx**	**Sl**		-	+	-	-	-	-
Trametes versicolor (L.) Lloyd	**EPx**	**Sl**		-	+	+	+	+	+
Trametes pubescens (Schumach.) Pilát	**Ex-EPx**	**SPl**		-	+	-	-	-	-
Trichaptum abietinum (Dicks.) Ryvarden	**EPX**	**Sl**		-	-	**+**	-	-	-
Order Russulales **FamilyAuriscalpiaceae**									
Auriscalpium vulgare S.F.Gray	**EPx-Gs**	**Sl**		-	-	-	-	+	-
FamilyBondarzewiaceae									
Heterobasidion annosum (Fr.) Bref	**Ex-EPx**	**SPl**		-	-	+	+	+	+

Family Peniophoraceae									
Peniophora laeta (Fr.) Donk	**EPx**	**Sl**			+	-	-	-	-
FamilyRussulaceae									
Lactarius deliciosus (L.) Gray	**Gm**	**M**	**X**	-	+	-	-	-	-
Lactarius deterrimus Gröger	**Gm**	**M**		-	-	-	+	-	-
Lactarius glyciosmus (Fr.) Fr	**Gm**	**M**		-	+	-	-	-	-
Lactarius subdulcis (Bull.) Gray	**Gm**	**M**		-	+	-	-	-	-
Lactarius salmonicolor R. Heim & Leclair	**Gm**	**M**	**X**	-	-	-	+	-	-
Lactarius zonarius Bull. ex Fr.	**Gm**	**M**		-	+	-	-	-	-
Russula adusta (Pers.) Fr.	**Gm**	**M**		-	+	-	-	-	-
Russula atropurpurea (Krombh.) Britzelm	**Gm**	**M**	**X**	-	+	+	+	-	-
Russula cyanoxantha (Schaeff.) Fr	**Gm**	**M**	**XX**	-	+	-	-	-	-
Russula delica Fr	**Gm**	**M**	**XX**	-	+	-	-	-	-
Russula fellea (Fr.) Fr.,	**Gm**	**M**			+	-	-	-	-
Russula foetens (Pers.) Pers.	**Gm**	**M**		-	+	+	+	+	-
Russula fragilis (Pers.) Fr.	**Gm**	**M**		-	+	-	-	-	-
Russula grisea (Batsch) Fr.	**Gm**	**M**	**X**	-	+	-	-	-	-
Russula heterophylla (Fr.) Fr.	**Gm**	**M**	**XX**	-	+	+	+	+	-
Russula integra var *integra* (L.) Fr.	**Gm**	**M**	**X**	-	-	+	+	+	-
Russula rosea Pers.	**Gm**	**M**	**X**	-	+	-	-	-	-
Russula sardonia Fr.	**Gm**	**M**		-	-	-	-	+	-
Russula sororia Fr.	**Gm**	**M**		-	+	-	-	-	-
Russula vesca Fr.,	**Gm**	**M**	**XX**	-	+	-	-	-	-
Russula violacea Quél.	**Gm**	**M**		-	+	+	-	-	-
Family Stereaceae									-
Stereum hirsutum (Willd.) Pers.	**Ex - EPx**	**SPl**		-	+	-	-	-	-
Xylobolus frustulatus (Pers.) Boidin	**Ex - EPx**	**SPl**		-	+	-	-	-	-
Chondrostereum purpureum (Pers.) Pouza	**EPx**	**Sl**		-	+	-	-	-	-
Order Thelephorales **FamilyThelephoraceae**									
Thelephora terrestris Ehrh.	**GM**	**M**		-	+	-	-	-	-
Thelephora caryophyllea (Schaeff.) Pers.	**GM**	**M**		-	+	-	-	-	-
Subclass Tremellomycetidae **Order Tremellales** **Fam Exidiaceae**									
Exidia glandulosa (Bull.) Fr.	**Ex- EPx**	**SPl**		-	+	-	-	-	-
Exidia saccharina Fr.	**EPx**	**Sl**		-	-	+	-	-	-
Family Tremellaceae									
Tremella mesenterica Retz	**EPx**	**Sl**		-	+	-	-	-	-
Total species 236				**17**	**177**	**55**	**59**	**48**	**28**
Abbreviations									
Biological form									
Gm - mycetogeophyta mycorrhiza (micorrhizant mushrooms)	**55**				36	12	15	16	2
Gs - mycetogeophyta saprophytica (saprophyte mushrooms whose mycelium is in the soil or in places characterized by plenty of remains of herbaceous plants, fruit, and leaves fell down)	**75**			10	50	25	27	23	17
Gp – mycetogeophyta parasitica (mushrooms whose mycelium is in the underground plant organs)	**1**			1					
Gs-EPx - mycetogeophyta saprophytica - mycetoepixilophyta	**4**				3		2		1
Th – mycetotherophyta (short living mushrooms)	**9**			6	7	3		2	3
EPx – mycetoepixilophyta (mushrooms whose life cycle takes place on dead wood)	**54**				49	9	9	3	3
EPx-Gs – mycetoepixilophyta - mycetogeophyta saprophytica	**3**				2	1		1	

Ex – mycetonedoxilophyta (mushrooms whose life cycle takes place in the body of the wooden plants)	**6**				5	2			
Ex-EPx - mycetonedoxilophyta - mycetoepixilophyta	**29**				26	3	4	3	3
Ecological category									
M - mycorrhizal species		**55**			36	12	15	16	2
Sf - saprotrophic species on leaf		**17**			11	12	13	12	10
St - saprotrophic species on soil or humus		**59**		13	41	13	13	9	6
Sc - coprophilous species		**3**		3	2	1	1	1	2
Sl - saprotrophic species on dead wood		**58**			49	9	10	6	4
SPl - saproparasite species on wood		**29**			26	3	4	3	3
Pl - parasite species on living trees		**6**		1	4	2			
Sh-Sl - saprotrophic on humus or on dead wood		**6**			5		3	1	2
Sf-Sl - saprotrophic on leaf or on dead wood		**3**			3	3			
Eatable - Food values			**67 (28%)**	**6**	**49**	**16**	**20**	**18**	**9**
X – eatable with little food value			41	4	31	11	11	11	6
XX - eatable with a lot of food value			16		12	4	6	4	1
XXX - eatable with great food value			10	2	6	2	3	3	2
Inedible – without sign			**153 (65%)**	**8**	**120**	**34**	**33**	**23**	**17**
Toxicity			**17 (7%)**	**3**	**8**	**5**	**6**	**7**	
† - mushrooms wich cause gastrointestinal intoxication			7	2	6	1	1	**3**	
†† - mushrooms wich cause intoxication of the nervos system			6		1	2	3	**3**	
††† - mushrooms wich cause fatal intoxication			4	1	1	2	2	**1**	
Biotops: 1 - maedows, 2 - Riparian mixed forest, 3 - collection - genus *Abies (firs)*, 4 - collection - genus *Picea* 5 - collection - genus *Pinus (pines)*, 6 - collection - genus *Larix (larchs)*.									

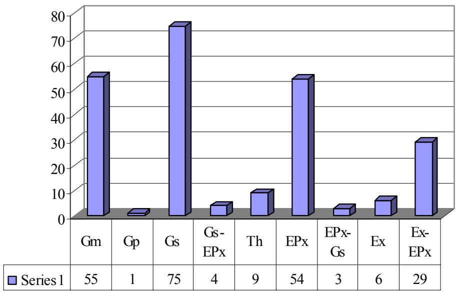

Fig. 2 - Bioforms spectrum of the macromycetes collected in Hemeiuş Arboretum

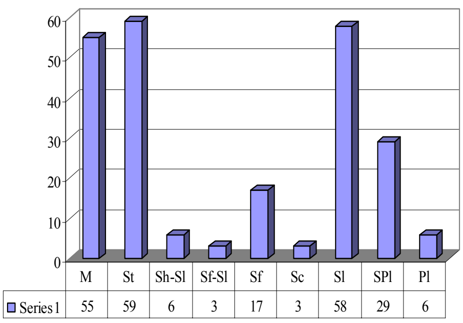

Fig. 3 - Ecological spectrum of the macromycetes collected in Hemeiuş Arboretum

Conclusions

The researches effectuated between the years 1997 and 2005 contribute at the cognition of the biodiversity of the macromycetes in Hemeiuş Arboretum.The 236 species of macromycetes identified belong to: 2 phylums, 2 classes (22 Ascomycetes and 214 Basidiomycetes), 14 orders, 51 families, and 112 genera.

The macromycetes species belong to 9 biological forms and 9 ecological categories. The bioforms spectrum is dominated by mycetogeophytes – 57 % and the ecological spectrum is dominated by saprotrophic species – 146 (61 %).

From the economic importance of view the most numerous are the inedible species – 153 (65%), followed by the edible species – 67 (28 %) and toxic 17 (7 %).

The mycological material was preserved and introduced in the collection of Macromycetes of the "Ion Borcea" Natural Scieces Museum in Bacău.

Rezumat

Cercetările efectuate, între anii 1997-2005, contribuie la cunoaşterea biodiversităţii ciupercilor din Arboretumul Hemeiuş, din judeţul Bacău. Un număr de 235 specii au fost citate pentru prima dată din acest parc. Au fost identificate un număr total de 236 de specii de macromicete din regnul Fugi, care se incadrează în 2 încrengături, 14 ordine, 51 de

familii,112 de genuri. Spectrul formelor biologice este dominat de mycetogeophyte – 57 %, iar spectrul ecologic este dominat de speciile saprofite – 146 (61 %), urmate de speciile micorizante -55 (23%). Din puct de vedere al importanței economice cele mai numeroase sunt speciile necomestibile - 153 (65 %), urmate de cele comestibile - 67 (28 %) şi toxice - 17 (7 %).

Cercetările au fost finanțate, pe toată perioada desfăşurării proiectului ştiințific, de Consiliul Județean Bacău.

Acknowledgments

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References

1. BARABAŞ N., FENERU F., 1995 - *Contribuții la flora şi vegetația spontană a parcului dendrologic Hemeiuşi*. Lucrare de licență, Universitatea Bacău, Secția Biologie-Ecologie, Bacău, 73 p.
2. BECKER, G., 2000 – *Champignons*. Grûnd, Paris: 224 pp.
3. BON M., 1988 - *Champignons de France et d'Europe Occidentale.* Ed. Arthaud, Paris: 345 pp.
4. BON M., 1990 - *Hygrophoraceae Lotsy*, *Flore Mycologique d'Europe*. Documents Mycologiques, Mémoire Hors serie N° , 99 pp.
5. BON M., 1991 - *Tricholomataceae (Fayod) Heim* (1ére partie), Flore Mycologique d' Europe. Documents Mycologiques, Mémoire Hors serie N° 2, 153 pp.
6. BON M., 1997 - *Tricholomataceae* (*Fayod) Heim* (2éme partie). Flore Mycologique d'Europe, Documents Mycologiques, Mémoire Hors serie N° 4, 173 pp.
7. BON M., 1997 – *Clitocyboideae*. Flore Mycologique d'Europe, 4, Documents Mycologiques, Mémoire Hors serie N° 4, 181 pp.
8. BON M., 1999 - *Collybio-MarasmÏoÏdes et resemblants*. Flore Mycologique d'Europe, 5, Documents Mycologiques, Mémoire Hors serie N° 5, 171 pp.
9. MIHALACHE A., 1988 - *Monografia Arboretumului Hemeiuş*. Centrul de Material Didactic şi Propagandă Agricolă, Bucureşti: 245 p.
10. SĂLĂGEANU GH., SĂLĂGEANU A., 1985 - *Determinator pentru recunoaşterea ciupercilor comestibile, necomestibile şi otrăvitoare din România*. Ed. Ceres, Bucureşti, 310 p.
11. *** - *Classification based on 9th edition of the Dictionary of the Fungi*. CABI Bioscience Databases. http://www.indexfungorum.org/Names/.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 69 – 71

OBSERVATION UPON ESSENTIAL OILS SECRETIVE STRUCTURES ON *THYMUS PANNONICUS* ALL. AND *THYMUS PULEGIOIDES* L.

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ABSTRACT

BERCIU I., TOMA C, 2006 – Observation upon essential oils secretive structures on *Thymus pannonicus* All. and *Thymus pulegioides* L. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol.21: 69-71.

The authors analyze the structure of the aerial vegetative organs on two *Thymus* species (*T. pannonicus* All. and *T. pulegioides* L.). It is underlined the presence of glandular trichomes which are always multicellular having a basal cell, a unicellular stalk and 1, 2 or 8 cells gland. It is underlined as well the early becoming from the stem's primary to the secondary structure but only on cambium activity.

Key words: anatomy, glandular trichomes, *Thymus*

Introduction

Thymus gender (*Lamiaceae*) is made of around 350 species in Europe, Northern Africa, Asia, Canary Islands. In flora of Romania are 16 species and 12 hybrids (A. Oprea, 2005). Different *Thymus* species are used around the world as medicinal, ornamental and spicy plants and are a source for essential oils.

Thymus pannonicus All. presents vigorous stems, branched, and covered by hairs with the same length of the axis diameter. The leaves are elliptic or prolonged, 6-12 mm in length and 3-5 mm width, green in color, both faces are covered with hairs, nervures little proeminent. The inflorescence is capitate. The calyx is 3-4 mm long, the corolla is lilac-red, 6-7 mm long (M. Guşuleac, 1961).

Thymus pulegioides L. has a thick rhizome. The aerial steam is strong, highly branched. The floral branches are serially disposed, being covered with little hairs only on the sides. The leaves are ovoid to semi-round or elliptical.

This paper is a first stage of research regarding the structure of glandular trichomes and the essential oils extracted from the two species, for the purpose of eventually linking the cyto-histological information with the biochemical data.

Material and methods

The biological material studied is represented by two *Thymus* species: *T. pannonicus* All., a species collected in august 2006 from the reservation Valea lui David (Iaşi) and *T. pulegioides* L., species collected in June 2006 from Neagra Şarului (Vatra Dornei).

For histo-anatomical research the vegetal material was firstly fixed and preserved in ethylic alcohol 70%. We have made cross sections at the aerial vegetative organs (stem – the superior, medium and inferior level; lamina, sections lately colored by iodine-green and carmine-red.

Results and Disscusions

Stem

At *Thymus pannonicus* the epidermis cells are isodiametric or slowly tangentially prolonged, having the external wall thickened, but covered by an extremely thin cuticle. Here and there, all over the stem's circumference there are tector and glandular trichomes. The tector trichomes are very frequently met, being mostly multicellular than unicellular, the terminal cell having a sharp, pointed pick. The glandular trichomes are always multicellular having a basal cell, smaller than the epidemical ones between which it is situated, and unicellular short stalk and a gland made of 1, 2 or 8 cells, all covered with a common, waved cuticle (fig.9). Still of the epidemical level there are stomata, whose cells are little prominent over the level of the protective cells. In the inferior level of the stem we notice that the frequency of the tector trichomes and both the glandular ones is reduced.

The cortex is relatively thin, parenchymatous assimilator, of meatic type between the ribs and predominantly of colenchymatical type inside the ribs. At the interior side of the collenchymatous

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strings there are 2-3 layers of parenchymatous cells, without chloroplasts or having just a few. The cortex ends in a Casparyan type endoderma, having tangentially prolonged cells of different size.

At the stele from the bottom of the stem (fig. 3), the structure is of a secondary type, resulting from the activity of the cambium: a very thin ring of phloem and a thick ring of xylem completely lignified. In the superior level of the stem (fig. 1), the stele has many conductive phloemic bundles of opened collateral type, from which those facing the ribs are much bigger; the meristematical tissue also produced some phloemic elements to the exterior and some xylemic vessels to the inside.

The pith is thick, with a large central aeriferal cavity.

At *Thymus pulegioides*, the epidermis has izodiametric cells, with the external walls thicker than the others and covered with a stripped-crenulated cuticle.

The leaf

At *Thymus pannonicus*, in cross section of the lamina, we noticed that the midrib is a little prominent at the inferior side of the lamina and has only one big bundle of conductive xylem-floem, which has a very thick string of sclerenchymatical fibres, coming from the phloem and going up to the epidermis of the abaxial face. Both epidermis are made of small tangentially prolonged cells having the external wall much thicker than the others (fig. 7).

From place to place, especially on the margins of the lamina, there are differently lengthed tector trichomes, the short ones being unicellular. On both sides of the epidermis we can notice also glandular trichomes, placed more oftenly in little epidermis depressions, being structurally similar to those observed on the stem.

The mesophyll consists of palisadic tissue at the upper epidermis and lacunous tissue at the lower one, so the limb has a bifacially- heterofacially structure.

At *Thymus pulegioides* , the upper epidermis is smooth having stomata from place to place and also very short tector trichomes with pointed pick; the epidermical cells have the external wall thicker than the others, and also covered with a thin cuticle (fig. 8). At the lower epidermis, in the holes, there are glandular trichomes having tetra- or octocellular glands. Still at this level, the stomata appear frequently and the tector trichomes are missing.

Conclusions

- Both species have two trichomes types: tector and glandular, and the first being multicellular.
- The glandular trichomes are always multicellular, having instead an unicellular basal, an unicellular stalk and the gland made of 1, 2 or 8 cells.
- The stomata are diacytic type, appearing in both epidermis, so the lamina is of amphystomatic type.
- The secondary structure of the stem appears early, only because of the cambium activity.

References

1. BAILLAUD L., 1960 – *À propos de la gaine caspariénne de la tige de certaines Labièes*. Ann. des sci. de l'Univ. de Besançon, ser. 2, Bot., 15: 37-51
2. GUŞULEAC M., 1961 - *Labiatae. În Flora R.P. Române*, VIII. Ed. Acad. Rom., Bucureşti
3. HARLEY R.M., REYNOLDS T., 1992 - *Advances in Labiatae science*. The Royal Garden, Kew.
4. METCALFE C. R., CHALK L., 1979 - *Anatomy of the Dycotiledons* (2 th edition), **1**, Claredon Press, Oxford.
5. RUDALL P., 1980 - *Leaf anatomy of the subtribe Hyptidinae (Labiatae)*. Bot. J. Linn. Soc., 80: 319-340.
6. RUGINA R., TOMA C., 1995 - *Recherches histo-anatomigue sur quelques plantes medicinales. V. Labiatae*, An. St. Univ. „Al.I.Cuza", Iasi, s.II.a (Biol. Veget.), 41: 17-22.

Fig. 1-*Thymus pannonicus* stem – the superior level

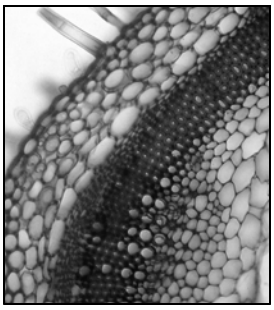

Fig. 2 -*Thymus pannonicus* stem – the medium level

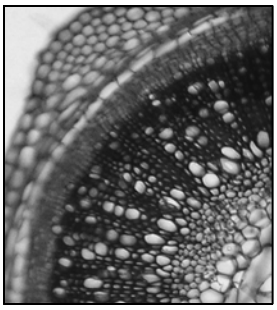

Fig. 3-*Thymus pannonicus* stem – the inferior level

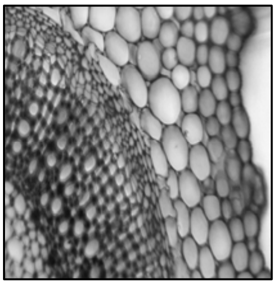

Fig. 4-*Thymus pulegioides* stem – the superior level

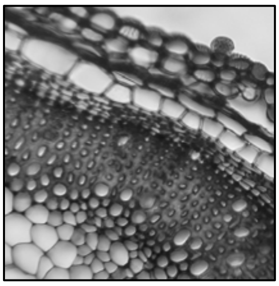

Fig. 5 -*Thymus pulegioides* stem – the medium level

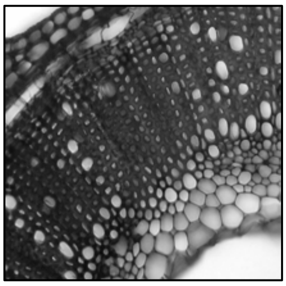

Fig. 6-*Thymus pulegioides* stem – the inferior level

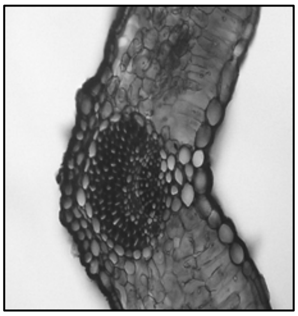

Fig.7 - *Thymus pannonicus* –lamina

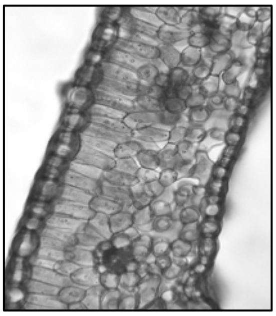

Fig. 8 - *Thymus pulegioides*- lamina

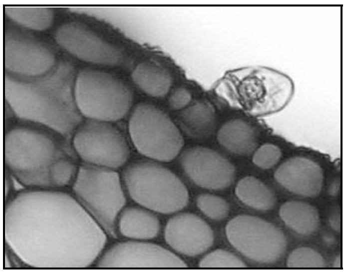

Fig. 9 - *Thymus pannonicus*- glandular trichome

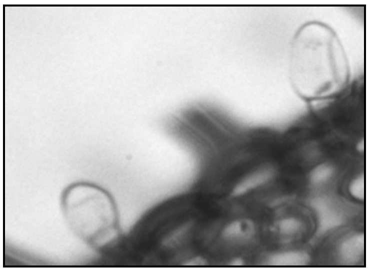

Fig.10 - *Thymus pulegioides*- glandular trichomes

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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HISTO-ANATOMYCAL ASPECTS OF THE VEGETATIVE ORGANS OF *SARRACENIA FLAVA* L. AND *SARRACENIA PURPUREA* L.

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ABSTRACT

STĂNESCU I. E., TOMA C., 2006 – Histo-anatomycal aspects of the vegetative organs of *Sarracenia flava* L. and *Sarracenia purpurea* L. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol.21: 72-81.

The authors present a few aspects referring to the structure of the vegetative organs of *Sarracenia flava* L. and *Sarracenia purpurea* L., underlining the differences that appear in the structure of the secretory glands, of the vascular bundles and of the mechanical elements.

Key words: secretory glands, sclerenchyma fibers, *Sarracenia*

Introduction

The genre was called in different ways, but finally it was renamed *Sarracenia*, in 1753, by Linné, in the Canadian scientist's honor, M. S. Sarrazin, who had sent him the plant for study.

The *Sarracenia* species are perennial herbaceous plants, terrestrial, of 10-100 high. The plant has a rhizome in the soil which can reach the age of 20-30 years; it forms many adventitious roots. The metamorphosed leaves have a trumpet form of various colours, erect (*Sarracenia flava*) or touching the soil (*Sarracenia purpurea*); they form a basal rosette from the center of which raises the floriferous stem. These trumpets represent the trap which helps the plant to capture different organisms; the organisms are attracted by the colour of the trumpet and the nectar which is secreted by the secretory glands of the hood.

The literature dealing with the anatomy of the *Sarraceniaceae* species, of carnivorous plants especially is quite rich, as it results from the synthesis works referring to the dicotyledons' anatomy (Solereder, 1899; Metcalfe and Chalk, 1972) or to the angiosperms' (Napp-Zinn, 1984). Various histo-anatomical aspects of the *Sarraceniaceae* species were mentioned by Juniper and co. (1989). In our country just a few articles have been published about carnivorous plants until now (Tarnavschi, 1957; Toma C. şi Toma I., 2002); in these synthesis works were underlined the carnivorous plants accommodations to surroundings.

Continuing our investigations regarding the anatomy of the carnivorous plants (Stănescu and colab., 2004, 2005, 2006), in the present work we evidenced a few structure characters of the vegetative organs of two *Sarracenia* species.

Material and method

The studied material, coming from the collection of the Botanical Gardens "Anastasie Fătu" of Iasi, belongs to two taxa, *Sarracenia flava* L. and *Sarracenia purpurea* L.

The material subjected to analysis (the vegetative organs of the plants) has been fixed and preserved in 70% ethylic alcohol. The sections (at the middle of the root and rhizome and at the base, middle and top of the trumpets) were cut with microtome, subsequently coloured with iodine green and alaun-carmine, then mounted in gel and analyzed in a Novex (Holland) light microscope. Drawings were obtained by employing a Romanian Projektionszeichenspiegel MC1 light microscope. The light micrographs were performed by means of Novex (Holland) microscope using Canon A95 camera.

Results and discussions

The root

At the analyzed level (the middle of the organ), the root evidences a primary structure, having the following well-known anatomical regions: rhizodermis, cortex and central cylinder.

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Rhizodermis consists of isodiametric cells with thick walls. *S. flava* has long root hairs. The cortex has three anatomical regions: exodermis, cortical parenchyma and endodermis; exodermis consists of 1-2 rows of isodiametric cells, with moderately-thickened and suberified walls. The cortical parenchyma has a lot of cell rows, with meatus and aeriferous cavities; it ends with a primary type endodermis, with Caspary thickenings in the radiary walls of its cells.

The central cylinder consists of 5 (*S. purpurea*- Fig. 21) or a lot of phloem isles (Fig. 5) with sieved tubes and companion cells and a compact, massive xylem consisting of sclerenchyma fibers (with thickened, but non-lignified walls) and a large number of solitary or grouped vessels (with thickened and lignified walls); they don't form typical bundles.

The rhizome

It is covered by foliar vaginas on the most part of its circumference. We can observe at least three foliar vaginas of semi-lune form in cross section.

The epidermis has tangentially elongated-cells, with the external wall thicker than the others. The cortex is thick, parenchymatic, meatus type; its cells have thin walls. The central cylinder has a large number of collateral vascular bundles with primary structure, separated by radial parenchymatic-cellulosed stripes. Some of the vascular bundles consist only of a few phloem elements (Fig. 22); others have phloem elements and a few xylem vessels, with moderately thickened, lignified walls; the biggest vascular bundles present phloem (sieved tubes and companion cells), few xylem vessels and a lot of sclerenchymatic fibers which are grouped at the phloem pole. All the vascular bundles categories are surrounded by a parenchymatic sheath, consisting of thin-walled cells. In the middle of the rhizome there is a thick pith, having the same structure as the cortex.

The leaf- The foliar vagina

It has a semi-lune form in cross section, wider in its medium region.

The epidermis of the adaxial face consists of tangentially elongated-cells, with thin walls. The epidermis of the abaxial face consists of isodiametric cells, with thick external walls and covered by a thin cuticle. Both epidermis, on both studied species, present secretory glands (Fig. 23). The foliar vagina has a paranchymatic mesophyll, but the latero-adaxial regions frequently consist only of the two epidermis (Fig. 6).

The vascular tissues form a lot of collateral vascular bundles (Fig. 7 and 24), of different diameters. All of them are surrounded by a parenchymatic sheath; the biggest vascular bundles present sclerenchymatic fibers grouped at the phloem pole. Phloem consists of sieved tubes and companion cells; xylem consists of a lot of vessels, irregularly disposed, surrounded by cellulosed parenchyma.

On successive cross sections of the trumpets, from the basis to the top, on both species, we observed that the foliar vagina becomes more and more thin, its wings come closed one to another, the epidermis of the adaxial face reduces and then completely disappears, resulting a massive body, having the structure similar to that occurring on a petiole (Fig. 1-3, 17-19).

In a half-closed foliar vagina (Fig. 2 and 18), there are a lot of well developed vascular bundles, with a thick band of sclerenchymatic elements at the phloem pole, having thickened and moderately-lignified walls.

In a completely-closed foliar vagina (Fig. 3 and 19), the external epidermis present isodiametric cells, smaller that those of the fundamental parenchyma; this epidermis is the same which belonged to the foliar vagina. In the homogenous parenchyma there are a lot of vascular bundles; the most external vascular bundles form a circle, the internal ones don't have a precise orientation. All of them are surrounded by a parenchymatic sheath. The bigger ones present a group of sclerenchymatic fibers at both phloem and xylem pole; other bundles have a group of sclerenchymatic fibers only at the phloem pole; the smaller ones don't have mechanical elements.

The inferior level of the trumpet

In the middle of the massive body (completely-closed foliar vagina) a cavity appears (Fig. 4 and 20) which enlarges, forming the cavity of the trumpet, presenting an internal and an external epidermis. The trumpet is oval in cross section, modified by a foliar expansion, resulted from the united wings of the foliar vagina. The epidermis of the internal (adaxial) face presents small cells, having the lateral walls thicker than the others. Here and there we observed a lot of long unicellular protective hairs (at *S. flava*).

The epidermis of the external (abaxial) face consists of isomorphic cells, but non-isodiametric, having the external wall thicker than the others, being covered by a thin cuticle. Here and there, a lot of secretory glands (Fig. 8 and 25) are present and the stomata are strongly prominent above the epidermis. *S. purpurea* has long protective unicellular hairs. There are differences only between the number of the component cells; all of them are implanted in the trumpet's wall.

The parenchyma is homogenous, having round cells, with meatus or aeriferous cavities between them. The cells next to those of both epidermis are smaller than the central ones; the cells belonging to the hypodermic layer are moderate colenchymatized.

The vascular tissues form a large number of collaterally-closed vascular bundles (Fig. 9 and 26), some of them are bigger than others; the biggest vascular bundles present a very thick band of sclerenchymatic fibers (having thickened, but moderately-lignified walls) at the phloem pole and only a few fibers at the xylem pole. Both studied species have all the vascular bundles surrounded by a parenchymatic sheath.

The middle level of the trumpet

Front side epidermis view: The internal epidermis presents cells with irregular profile, having thick, strong-waved lateral walls. Here and there, we sow secretory multicellular glands and a lot of long unicellular protective hairs, having a large basis and a very thick wall (only in *S. flava*).

The external epidermis (Fig. 10) presents cells with irregular profile, too, but the lateral walls are less-waved. Here and there, the epidermis presents a lot of short unicellular protective hairs, having a large basis and a very thick wall, stomata of anomocytic type and lots of secretory multicellular glands.

In cross section: the epidermis consists of small cells, having the lateral walls thicker than the others; here and there, secretory glands (Fig. 27) and protective hairs (only in *S. flava*) are present. The lower epidermis (external) consists of big cells, with the external wall thicker than the others, and covered by a thick cuticle (especially in the region where the biggest vascular bundle protrudes). Here and there, a lot of short protective hairs and stomata (prominent above the surroundings cells of the epidermis) are present.

The fundamental parenchyma is homogenous, having round hypodermic cells and tangential-elongated the central ones. Here and there we can see some large aeriferous cavities.

The vascular tissues form collaterally-closed vascular bundles (Fig. 11) of different size (alternating the biggest vascular bundles with the intermediate and the smaller ones); the formers consist only of a few phloem elements. The median vascular bundle has at both the phloem and the xylem pole a large band of sclerenchymatic fibers, having thick, but cellulosed walls; the intermediary vascular bundles have the mechanical band only at the phloem pole. All the vascular bundles are surrounded by a parenchymatic sheath.

The superior level of the trumpet

Front side epidermis view:

The internal epidermis (Fig. 28) has the same structure as does the one belonging to the middle level: waved-wall epidermic cells, long unicellular protective hairs (only at *S. flava*) and secretory glands. Most of the cells of *S. flava* present a prolongation that covers the subjacent cell. On transparency we observed the profile of the cells coming from the hypodermic layer.

The external epidermis (Fig. 12) has almost the same structure as does the one belonging to the middle level: short protective hairs, secretory glands, stomata of anomocytic type and epidermic cells, having less-waved walls.

In cross section, the "midrib" is a little prominent at the lower (external) face. The general structure is similar to that occurring in the middle level, having differences as follow: the cells of the upper epidermis are papilla-like shaped; there are a lot of secretory glands (Fig, 13), implanted in the trumpet's wall and stomata (Fig. 29); the lower epidermis has the external wall of the cells covered by a thick cuticle, especially where the "midrib" is; the median vascular bundle is the biggest, presenting a band of sclerenchyma fibers at both poles (phloem's and xylem's); the rest of the vascular bundles are smaller, consisting of few phloem and xylem elements; some of them present 1-2 sclerenchymatic fibers at the phloem pole; the fundamental parenchyma cells are tangentially elongated.

The hood

Front side epidermis view:

The internal epidermis consists of cells with irregular profile (having strong-waved lateral walls), a few stomata, short unicellular protective hairs (only at *S. purpurea*) with large basis and multicellular nectariferous glands, with the same structure like the ordinary secretory ones. These glands secrete the nectar that attracts the little organisms in the trump. At *S. purpurea* most of the cells belonging to the internal epidermis has an acuminate prolongation (Fig. 30) that covers the subjacent cell (this modification determines the prey's slippage). The external epidermis consists of irregular-profiled cells, a lot of stomata, but less secretory glands and short hairs.

In cross section, the "midrib" protrudes at the lower face.

The internal epidermis has small cells, short protective hairs at *S. flava*, but longer at *S. purpurea*; the other cells have papilla-like shape.

The cells which form the external epidermis are covered by a thin cuticle; there are a lot of stomata, prominent above the external wall of the surrounding cells, secretory glands (Fig. 14) and long unicellular protective hairs.

The fundamental parenchyma is homogenous, with lots of vascular bundles having similar structure as those occurring in the middle level. The secretory glands of both internal and external epidermis are deep implanted in the trumpet's walls, touching the parenchymatic cells.

The foliar expansion

It represents the unified wings region of the foliar vagina; it has the same length as the trumpet. It is narrow at *S. flava* and wide in its superior level, at *S. purpurea*; it is boarded by the external (lower) epidermis of the trumpet.

The epidermis consists of polygonal cells (viewed from the front side), having waved walls. It presents stomata of anomocytic type, multicellular secretory glands (Fig. 31) and short unicellular protective hairs (at *S. purpurea*).

In cross section, the epidermis presents izodiametric cells, having the external wall thicker than the others, covered by a thick cuticle. The secretory glands are present (Fig. 15). The fundamental parenchyma shows small cells, which form a hypodermic layer, and big cells in its middle region, resulting meatus and aeriferous cavities.

This structure presents collateral vascular bundles of different diameter and orientation. Frequently, some vascular bundles have the xylem that faces the xylem of another vascular bundle, and the phloem is outwards, facing one of the two faces of the foliar expansion. Infrequently, two vascular bundles combine their xylem poles, resulting one xylem body (consisting of few vessels), having tow phloem opposed poles; the phloem presents a band of sclerenchymatic elements. All the vascular bundles are surrounded by a parenchymatic sheath.

The peristom

It appears in the superior region of the trumpet, opposed to the hood. Its general structure is similar to that occurring in the rest of the trumpet and in the hood: both internal and external epidermis consist of secretory glands, stomata less prominent and a lot of protective hairs in the external epidermis. At both studied species (Fig. 16 and 32), each cell belonging to the internal epidermis has an acuminate prolongation that covers the subjacent cell (this modification determines the prey's slippage). The fundamental parenchyma is homogenous, having tangential-elongated cells; there are a lot of aeriferous cavities, larger than the meatus. Only the biggest vascular bundle has a band of sclerenchymatic fibers on both poles; the other ones have mechanical elements only at the phloem pole.

Conclusions

At *Sarracenia flava*, each vegetative organ is histo-anatomically similar to the correspondent one from *Sarracenia purpurea*. There are some differences regarding the vascular tissues of the root, the presence or absence of the protective hairs at some levels of the trumpets, of the bands of sclerenchymatic fibers; these ones have different thickness and consistency of the fibers (with lignified or non-lignified walls).

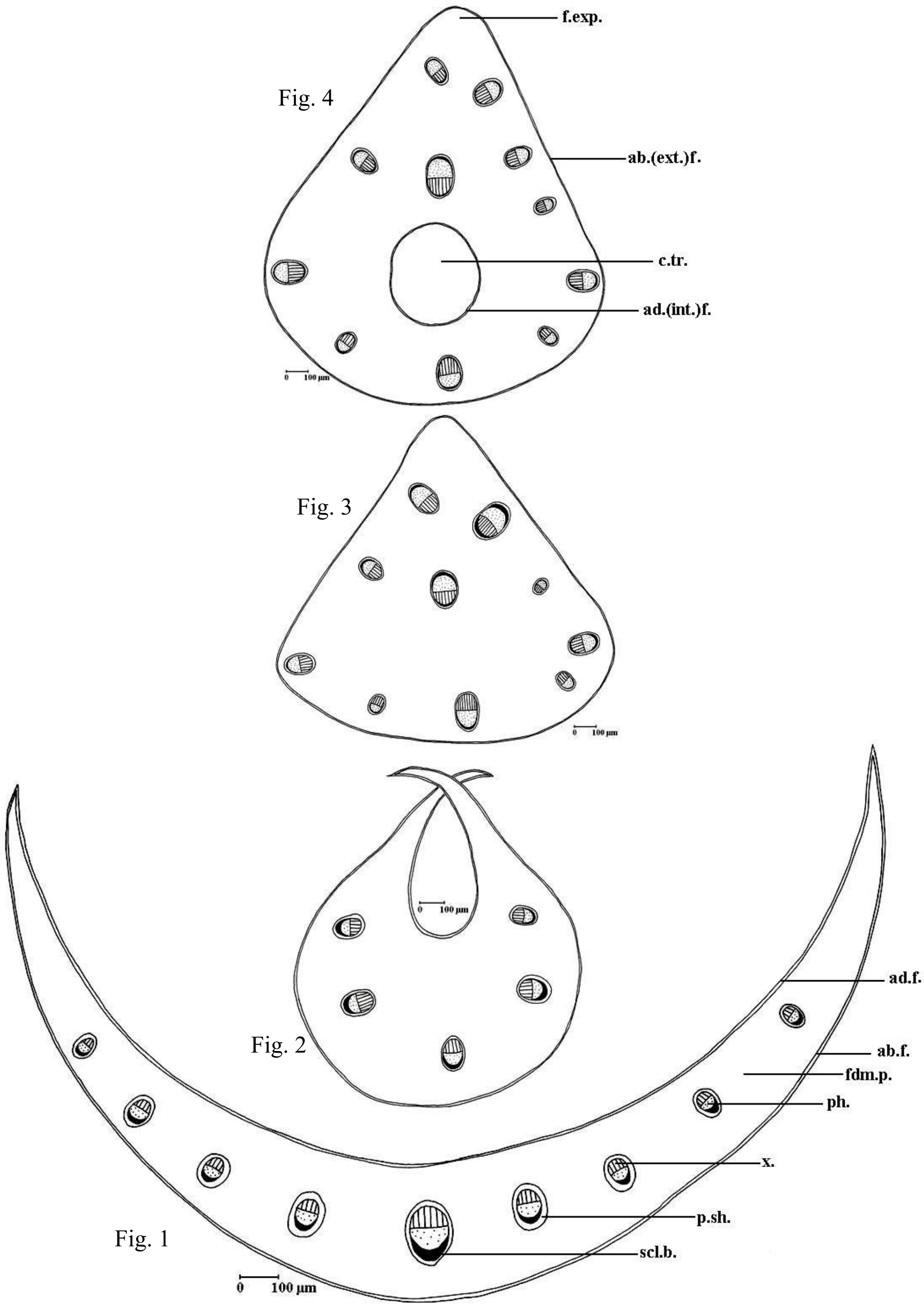
The trumpets of *Sarraceniaceae* species are adapted to catch small organisms, which are, then, digested. The secretory glands secrete digestive enzymes which kill the preys, decompose them and then absorb the resulted compounds, transforming them into its own compounds.

Rezumat

Autorii prezintă câteva aspecte referitoare la structura frunzei metamorfozate de la *Sarracenia flava* L. şi *Sarracenia purpurea* L., pe diferite niveluri, subliniind diferenţele ce apar în structura glandelor secretoare, fasciculelor vasculare şi elementelor mecanice.

References

1. JUNIPER B. E., ROBINS R. J., JOEL D. M., 1989- *The Carnivorous Plants*. Academic Press, San Diego.
2. METCALFE C. R., CHALK L., 1972- *Sarraceniaceae* (**1**: 71-74). In *Anatomy of the Dicotyledons*. Clarendon Press, Oxford.
3. NAPP-ZINN Kl., 1984 - *Anatomie des Blattes. II. Blattanatomie der Angiospermen. B. Experimentelle und ökologische Anatomie der Angiospermenblattes. Karnivore Angiospermen.* In Handbuch der Pflanzenanatomie, 8: 394-422, Gebrüder Borntraeger, Berlin, Stuttgart
4. SOLEREDER H., 1899 - *Systematische Anatomie der Dicotyledonen*. Fr. Enke Verlag, Stuttgart
5. STĂNESCU I., TOMA I., TOMA C., 2004- *Leaf structure considerations of some Drosera L. species*. Acta Horti Botanici Bucurestiensis (sub tipar)
6. STĂNESCU I., TOMA I., TOMA C., 2005 - *Considerations of the stem structure of some Drosera L. species.* Contribuţii botanice ale Univ. „Babeş-Bolyai", Cluj-Napoca, 40: 215-220
7. STĂNESCU I., TOMA I., TOMA C., 2005 - *Adventive root structure considerations of some Drosera L. species*. An. Şt. Univ. „Al. I. Cuza"Iaşi, S. II, a (Biol. veget.), 51: 15-22.
8. STĂNESCU I., TOMA C., TOMA I., 2005 - *Cyto-histological aspects in the modified leaf of Dionaea muscipula Ellis*. Acta Horti Botanici Bucurestiensis (sub tipar)
9. TARNAVSCHI I. T., 1957 - *Adaptările morfologice ale plantelor carnivore*, Natura, 4: 76-92
10. TOMA C., TOMA I., 2002 - *Plantele carnivore- un caz particular de adaptare la mediul de viaţă.* Prelegeri academice, Iaşi, 1: 103- 130.



Sarracenia flava. Fig. 1-3: Successive cross sections through the trumpet, from the basis to the top. Fig. 4: Cross section through the inferior level of the trumpet. ab.(ext.)f.= abaxial (external) face; ad.(int.)f.= adaxial (internal) face; c.tr.=cavity of the trumpet; f.exp.= foliar expansion; fdm.p.= fundamental parenchyma; p.sh.= parenchymatic sheath; ph.= phloem; scl.b.= sclerenchymatic band; x.= xylem.

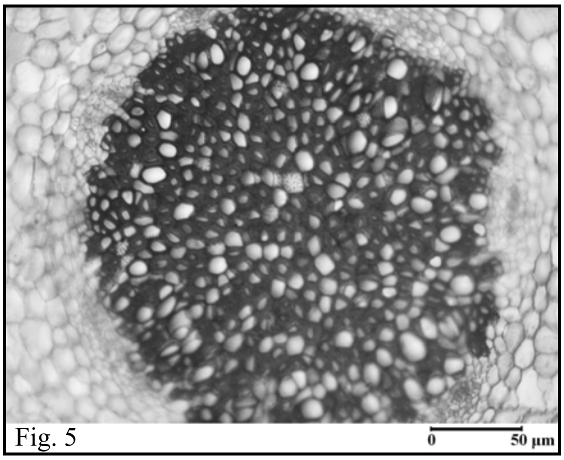


Fig. 5

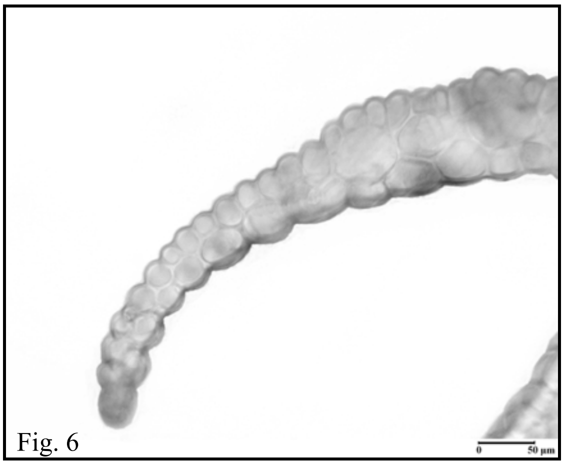


Fig. 6

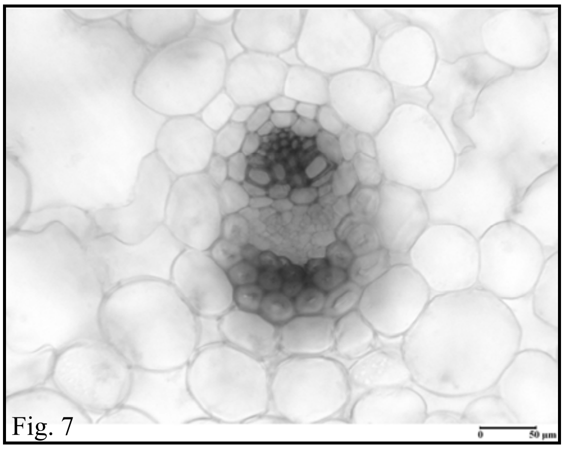


Fig. 7

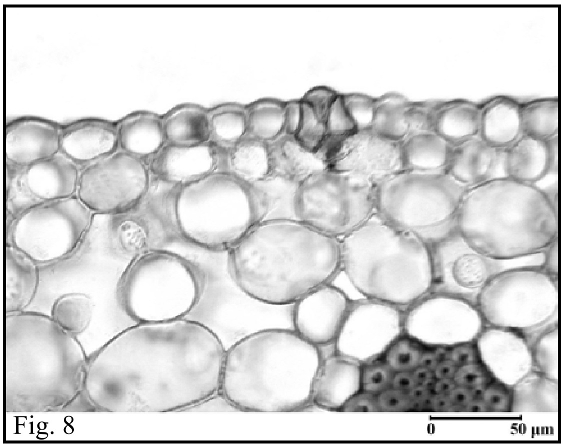


Fig. 8

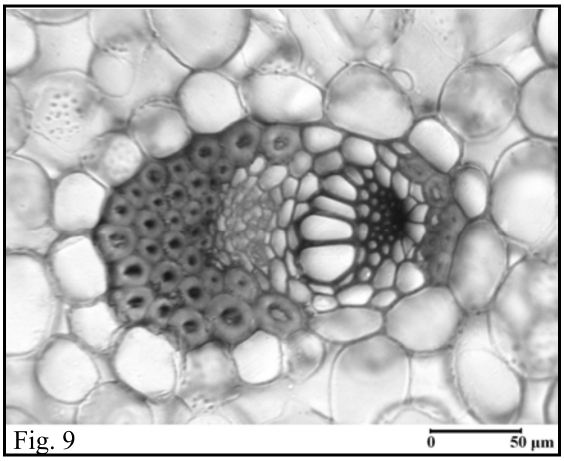


Fig. 9

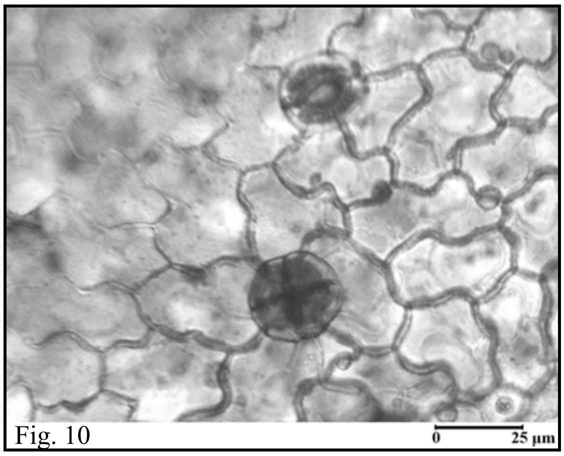


Fig. 10

Sarracenia flava. Fig. 5: Cross section through the root (detail: the central cylinder). Fig. 6: Cross section through the foliar vagina. Fig. 7: Cross section through the foliar vagina (detail: vascular bundle). Cross section through the inferior level of the trumpet: secretory gland of the external epidermis (Fig. 8) and vascular bundle (Fig. 9). Fig. 10: Cross section through the middle level: the external epidermis (front side view).

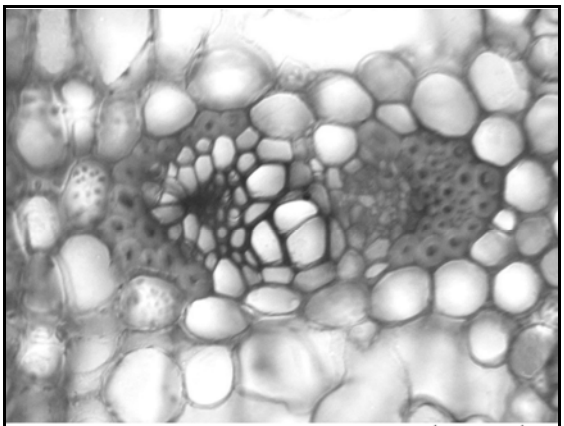


Fig. 11

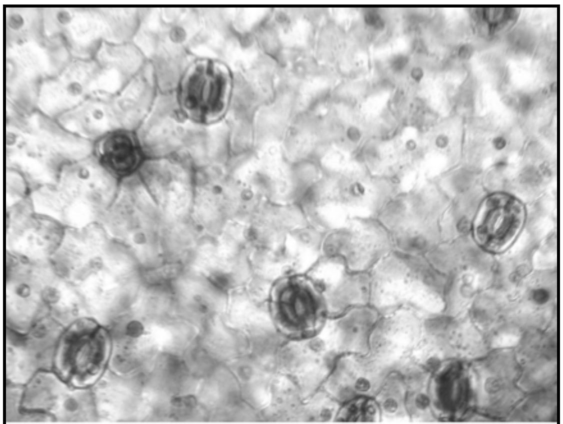


Fig. 12

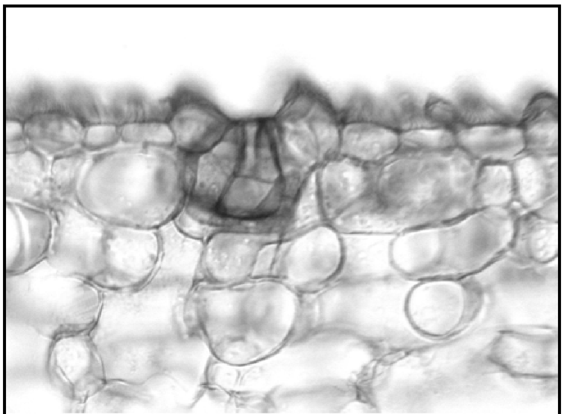


Fig. 13

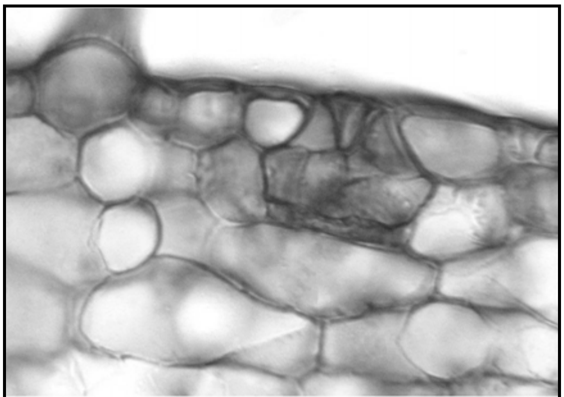


Fig. 14

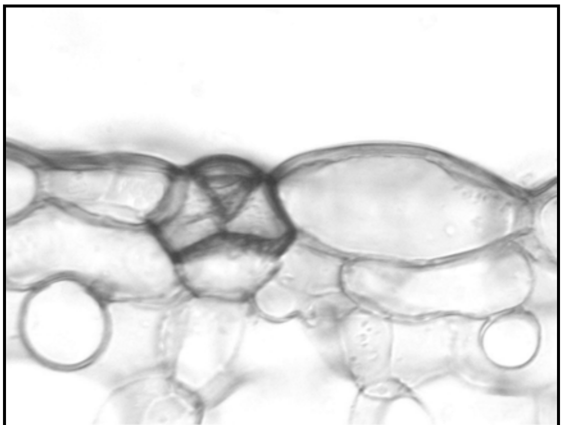


Fig. 15

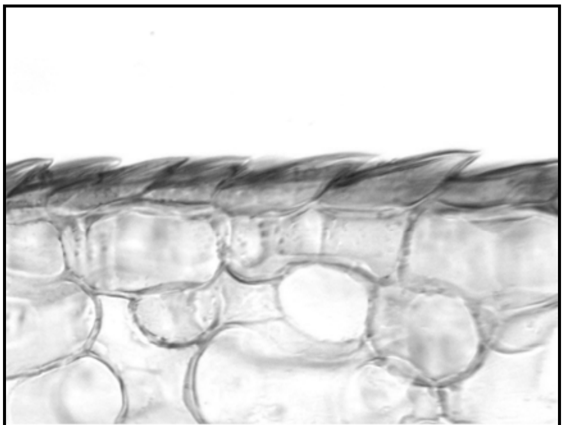
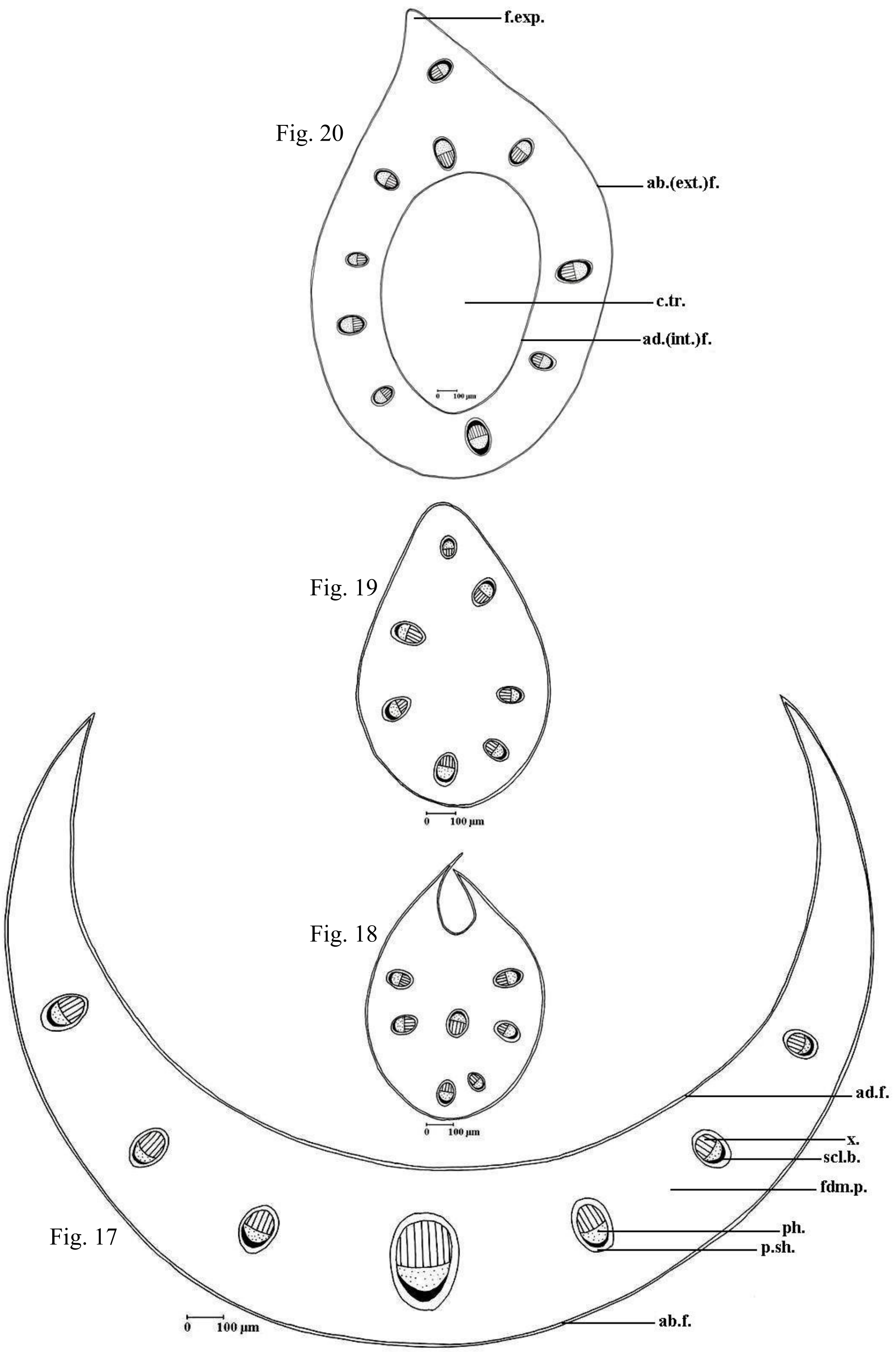


Fig. 16

Sarracenia flava. Fig. 11: Cross section through the middle level (detail: vascular bundle). Cross section through the superior level: the external epidermis, front side view (Fig. 12) and secretory gland of the external epidermis (Fig. 13). Fig. 14: Cross section through the hood (secretory gland of the external epidermis). Fig. 15: Cross section through the foliar expansion (secretory gland). Fig. 16: Cross section through the peristom (the internal epidermis).



Sarracenia purpurea. Fig. 17-19: Successive cross sections through the trumpet, from the basis to the top. Fig. 20: Cross section through the inferior level of the trumpet ab.(ext.)f.= abaxial (external) face; ad.(int.)f.= adaxial (internal) face; c.tr.=cavity of the trumpet; f.exp.= foliar expansion; fdm.p.= fundamental parenchyma; p.sh.= parenchymatic sheath; ph.= phloem; scl.b.= sclerenchymatic band; x.= xylem.

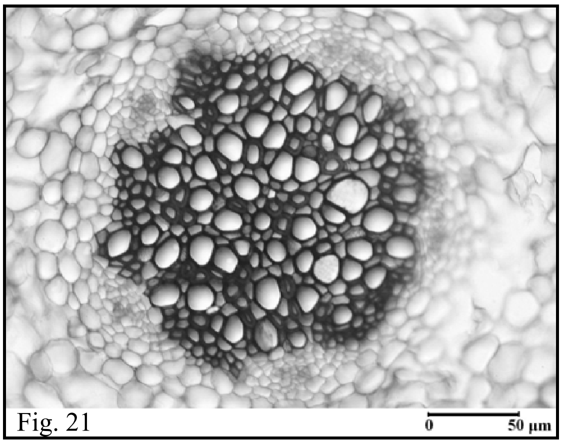


Fig. 21

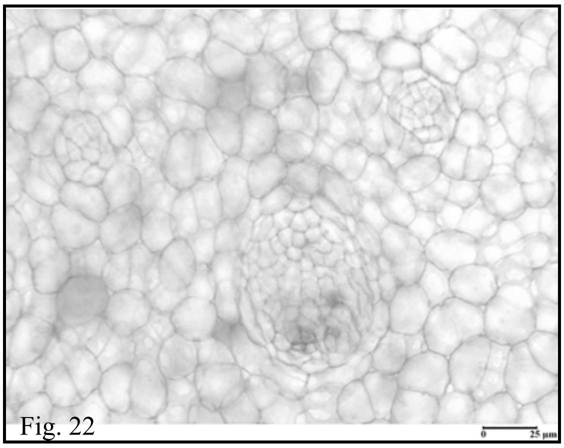


Fig. 22

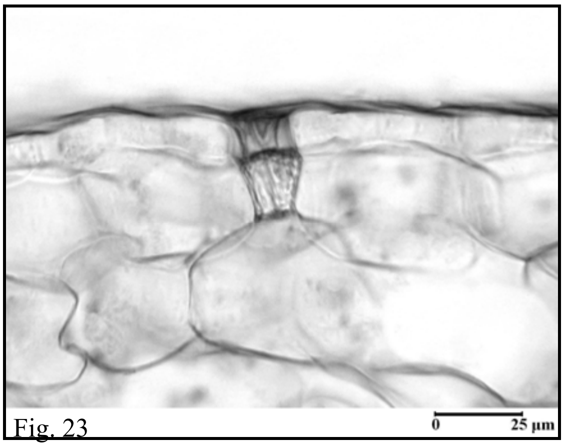


Fig. 23

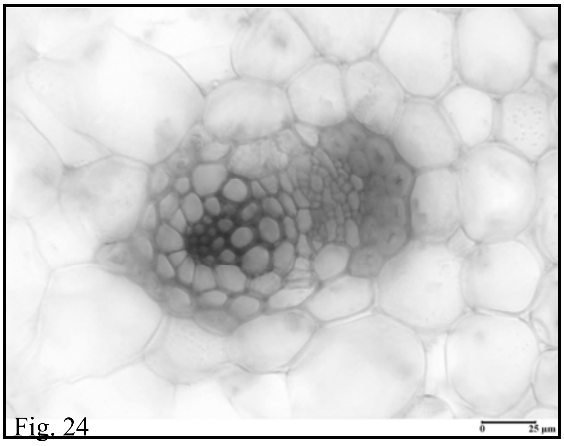


Fig. 24

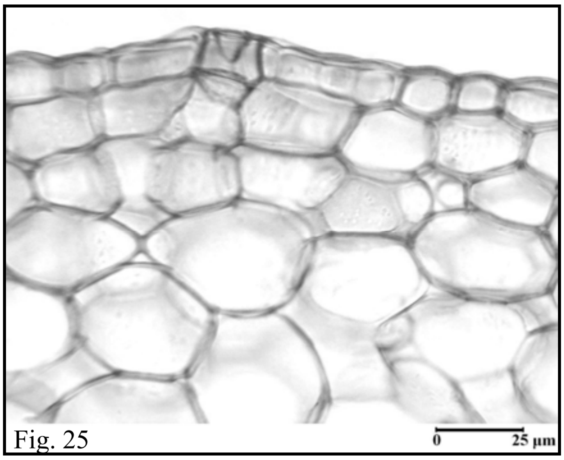


Fig. 25

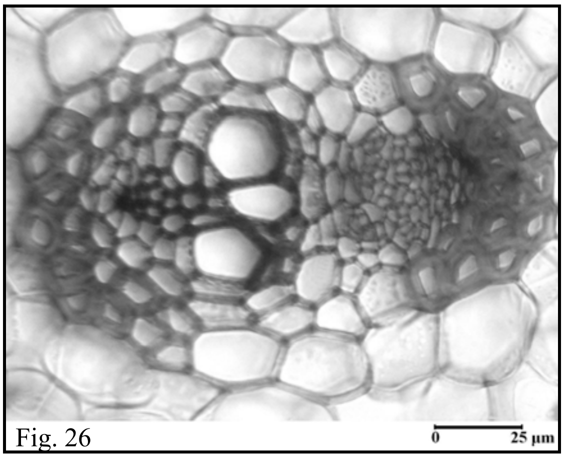


Fig. 26

Sarracenia purpurea. Fig. 21: Cross section through the root (detail: the central cylinder). Fig. 22: Cross section through the rhizome (detail: vascular bundle). Cross section through the foliar vagina: secretory gland in the epidermis of the abaxial face (Fig. 23) and vascular bundle (Fig. 24). Cross section through the inferior level: secretory gland in the internal epidermis (Fig. 25) and vascular bundle (Fig. 26).

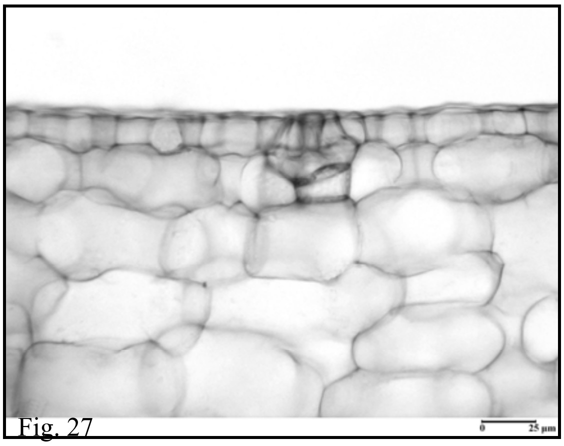


Fig. 27

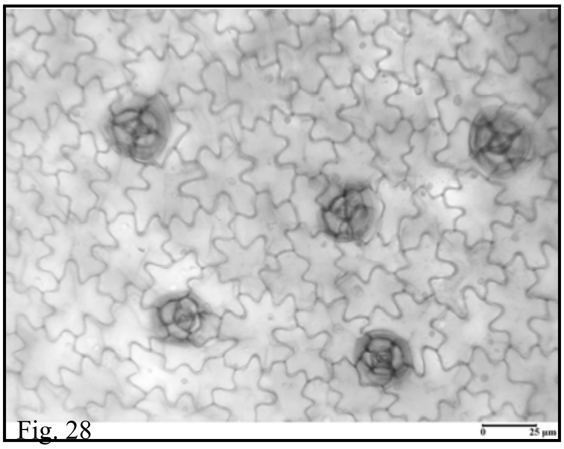


Fig. 28

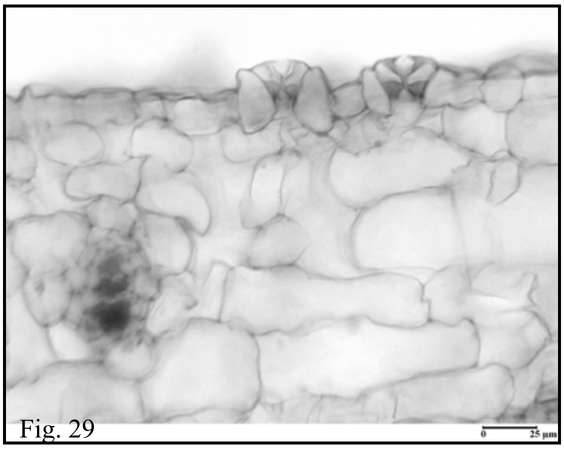


Fig. 29

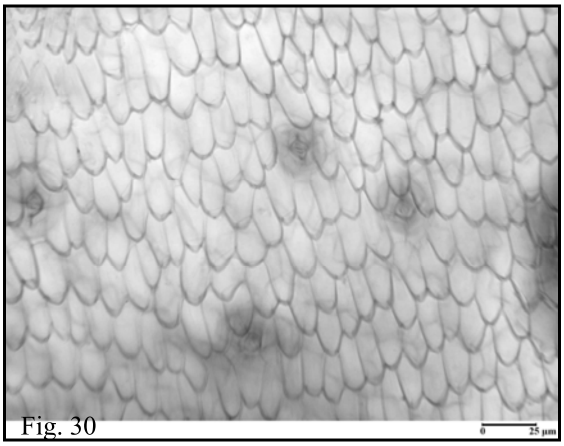


Fig. 30

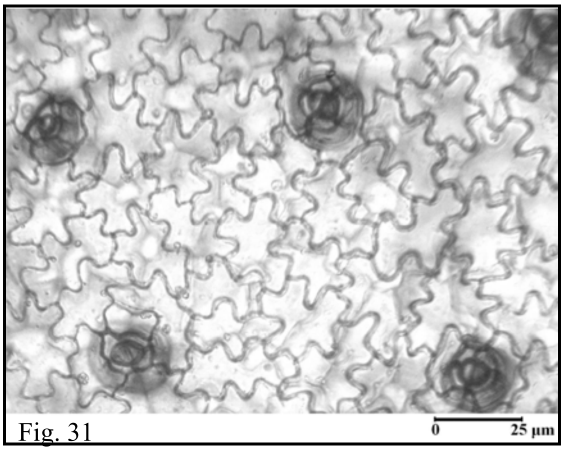


Fig. 31

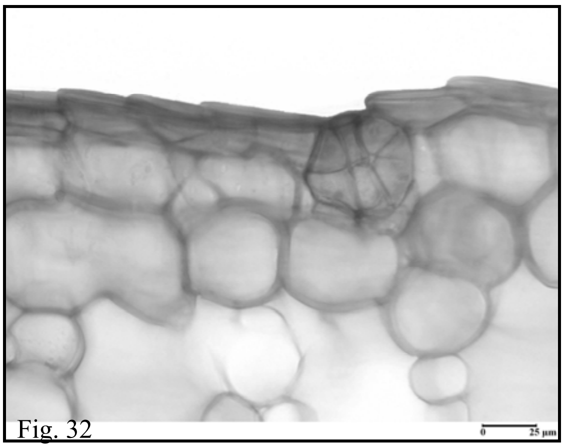


Fig. 32

Sarracenia purpurea. Fig. 27: Cross section through the middle level: secretory gland in the internal epidermis. Cross section through the superior level: the internal epidermis, front side view (Fig. 28) and stomata (Fig. 29). Fig. 30: Cross section through the hood: the internal epidermis, front side view. Fig. 31: Cross section through the foliar expansion: front side view. Fig. 32: Cross section through the peristom: secretory gland in the internal epidermis.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 82 – 86

INVESTIGATIONS UPON THE VEGETATIVE ORGANS ANATOMY AT SOME *EUPHORBIA* SPECIES FROM THE ROMANIAN FLORA

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CONSTANTIN TOMA*

ABSTRACT

GALEŞ R.C., TOMA C., 2006 – Investigations upon the vegetative organs anatomy at some *Euphorbia* species from the Romanian flora. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 82-86.

The authors investigate the phenomenon of cross-breeding between *E. glareosa* Pallas and *E. seguieriana* Neck., by comparison of histo-anatomical characters of *E.* x *angustifrons* Borb. hybrid taxon with those of the genitors. The results of our researches point out that the vegetative organs of *E. angustifrons* most resembles with those of *E. seguieriana* by the following anatomical characters: 1. the rhizome- the alternation between compact masses of vessels and libriform and tangential zones of cellulosic parenchyma, cortical cordons of sclerenchymatous fibers, numerous laticifers in the secondary phloem 2. the aerial stem – the cubic shape of epidermis cells, one layer of tangential collenchyma at the periphery of the cortex, cortical parenchyma of meatic type; 3. the foliar limb – the structure of the median nervure and epidermis.

Key words: *Euphorbia*, hybrid, anatomy, vegetative organs

Introduction

Following-up on our histo-anatomical researches on the vegetative organs of some *Euphorbia* taxa (Rotari, 2004; Rotari & Toma, 2004; Galeş & Toma, 2005, Galeş & Toma, 2006 [a], [b], [c, [d] [e]), this paper analyzes comparatively the structure of the rhizome, aerial stem and leaf of 3 *Euphorbia* species from the Romanian flora.

The existing literature on the anatomy of *Euphorbia* species is quite rich, if considering the researches on the origin, development and structure of non-articulated laticifers and it might be considered poor, if one takes into account the papers exclusively devoted to the anatomy of the vegetative organs of the species from this genus.

The most ample paper which analyzes the structure of the stem and leaf of species from the *Euphorbiaceae* family is that of Gaucher (1902). Succinct references on the structure of the vegetative organs of some *Euphorbia* species are founded in some general treatises which analyze the angiosperms anatomy published by Solereder (1899), Bonnier G. & Leclerc du Sablon (1905), Metcalfe & Chalk (1972) and Esau (1965).

The Romanian literature of the field includes no study exclusively on the structure of the *Euphorbia* species; there are only a few data on the structure of some vegetative organs (Ivănescu & Toma, 2003, Tudose, 2001) or general mentions in some lectures and manuals of Anatomy and Morphology of Plants (Grinţescu, 1985; Şerbănescu-Jitariu & Toma, 1980; Toma & Gostin, 2000).

Material and methods

The material utilized in the study belongs to 3 *Euphorbia* taxa (*E. glareosa* Pallas*, E. seguieriana* Neck. şi *E.* x *angustifrons* Borb.), collected from Dobrogea.

The material fixed and preserved in ethylic alcohol, has been subsequently processed (cross-sectioned, coloured with iodine green and ruthenium red and inserted into glicero-gelatina), according to the currently applied methods in vegetal anatomy investigations. The permanent slides obtained have been analyzed with a Novex (Holland) microscope and have been photographed on the same microscope with a Sanyo digital camera.

Results and discussions

According to the speciality literature (Prodan, 1953), *Euphorbia* x *angustifrons* Borb. is considered to be a hybrid between *E. glareosa* Pallas and *E. seguieriana* Neck., having intermediate characters between parents which regard the length and thickness of the stems, the size and shape of the leaves. From *E. glareosa*, the hybrid has long root, short rhizome, umbel with 7-8 rays. It resembles

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with *E. seguieriana* by the lanceolate, acute or acuminate leaves, which have 5-6 mm width and 4-5 cm length.

The structure of the rhizome

In all the investigated taxa, the rhizome presents secondary structure which results from the activity of both lateral meristems, the cambium and the phellogen.

The phellogen, arising in the outer cortex, produces many cork layers with thickened and suberized walls and a few phellodermis, with tangentially elongated and slightly collenchymatized cells.

In all the analyzed taxa, excepting *E. glareosa*, in the thickness of the cortex and at the phloem periphery, thick (in *E.* x *angustifrons*) or thin (in *E. seguieriana*) cordons of sclerenchymatous fibers, with very thick and weakly lignified secondary walls, may be observed. The secondary conducting tissues are of annular type, the xylem representing the most voluminous tissue of the rhizome. The phloem ring is thick in *E.* x *angustifrons* and *E. seguieriana*, comparatively with *E. glareosa*, in its thickness many laticifers of different size and with thick, but cellulosic walls, being present.

In the rhizome of *E.* x *angustifrons* and *E. seguieriana*, the secondary xylem comprises compact masses of vessels and libriform fibers which alternate with tangential zones of cellulosic parenchyma, in which isolated groups of xylem vessels are founded. In *E. glareosa*, the secondary xylem is almost totally lignified, being penetrated by medullar multiseriate and partially lignified rays (Figs. 1, 2, 3).

The rhizome's pith is thin, being of parenchymatous cellulosic type; at the periphery of the pith, the vessels of primary xylem surrounded by a few cells of cellulosic parenchyma are present.

The structure of the aerial stem

Along the aerial stem of all the investigated taxa, the passing from the primary structure to the secondary structure may be observed.

The epidermis presents parenchymatous cellulosic cells of cubic shape with thick periclinal walls. In *E. glareosa*, the epidermis cells are of papilla shape, most of them forming very short prickle-shaped hairs.

The stomata are of anomocitic-type, having a shallow suprastomatal chamber, with the exception of *E. seguieriana*, in which the stomata cells are located on the same level with the epidermis cells.

The primary cortex may be divide into 3 zones, among which, only the internal ones is similar in organization in all the investigated taxa, being relatively compact and having numerous and big laticifers. The tangential collenchyma from the periphery of the cortex is represented by one (in *E.* x *angustifrons* and *E. seguieriana*) or more layers (in *E. glareosa*). The midlle zone is thin, parenchymatous-cellulosic of meatic type, with the exception of *E. glareosa*, in which it is thick and presents numerous and big aeriferous cavities (Figs. 4, 5, 6):

In the aerial stem's zone with primary structure, the stele comprises a variable number (20-50) of vascular bundles of collateral open type, disposed on a circle. At the periphery of the phloem, cordons of incipient sclerenchymatous fibers of polygonal contour in transverse section, with more or less thick and not yet lignified walls are present (Fig. 7).

The secondary structure of the aerial stem results exclusively from the cambium's activity, the formed conducting tissues being of annular type

In the thickness of the secondary xylem, the libriform formed by fibers with very thick, moderately lignified and partially gelified secondary wall, is predominated (Fig. 8).

In the aerial stem's zone with secondary structure the sclerenchymatous fibers are completely formed, having a very thick and weakly lignified secondary wall, the most part of it being gelified (Fig. 9).

The pith is parenchymatous cellulosic, presenting numerous and big aeriferous cavities; in the lower level of the *E.* x *angustifrons* aerial stem, the walls of the cells of the pith are lignified.

The structure of the leaf

In all the analyzed taxa, the foliar limb has homogenous mesopyll (Fig. 10), being formed by cells disposed in palisade.

The median nervure comprises a single vascular bundle of variable size and, excepting *E. glareosa* (Fig. 10), it not prominent on the abaxial face of the limb.

The surface of the foliar limb presents polygonal cells with straight lateral walls (Fig. 11) in transverse section epidermis cells are tangential elongated or approximately isodiametrical, the external wall being more thick than the others and covered by a cuticle of variable thickness. In *E. glareosa,* most of epidermis cells are of papilla shape.

The foliar limb is amphistomatic, the stomata being of anizocitic and anomocitic-type, with the exception of *E.* x *angustifrons*, in which only stomata of the latest type are present.

In all investigated taxa, the stomata cells are small and are located under the external level of the epidermis, being formed a shallow suprastomatal chamber.

In all (subterranean and aerial) vegetative organs of the taxa taken into study, laticifers, localized in certain tissues (cortical parenchyma, phloem, assimilatory foliar tissues) may be observed. The laticifer wall is always celullosic, uniformly thick (Fig. 12).

Conclusions

From structural point of view, the vegetative organs of *E. angustifrons* most resembles with those of *E. seguieriana*, by the following histo-anatomical characters: 1. in the rhizome- the alternation between compact masses of vessels and libriform and tangential zones of cellulosic parenchyma, cortical cordons of sclerenchymatous fibres, numerous laticifers in the secondary phloem 2. in the aerial stem – the cubic shape of epidermis cells, one layer of tangential collenchyma at the periphery of the cortex, cortical parenchyma of meatic type; 3. in the foliar limb – the structure of the median nervure and epidermis.

All the investigated taxa present constant characters: laticifers with cellulosic thick walls in all the vegetative organs; periphloemic cordons of sclerenchymatous fibers and libriform gelatinous fibers in the structure of the aerial stem; numerous vascular bundles in the stem's region with primary structure; amphistomatic foliar limb with homogenous mesophyll.

Rezumat

Autorii investighează fenomenul de hibridare între *E. glareosa* Pallas şi *E. seguieriana* Neck., prin compararea caracterelor histo-anatomice ale taxonului hibrid *E.* x *angustifrons* Borb. cu cele ale genitorilor. Rezultatele cercetărilor noastre evidenţiază faptul că aparatul vegetativ de la *E. angustifrons* se aseamănă mai mult cu cel de la *E. seguieriana*, prin următoarele caractere structurale: 1. rizomul-alternanţa de mase compacte de vase şi fibre libriforme cu zone tangenţiale de parenchim lemnos celulozic în xilemul secundar, cordoane de fibre sclerenchimatice corticale, numeroase laticifere în floemul secundar; 2. tulpina aeriană – forma cubică a celulelor epidermice, colenchim tangenţial unistratificat la periferia cortexului, parenchim cortical de tip meatic; 3. limbul foliar –mezofil omogen, structura nervurii mediane.

References

1. BONNIER G., LECLERC DU SABLON, 1905 - *Cours de Botanique.T.I.* Librairie générale de l'enseignement, Paris: 798-814
2. ESAU K., 1965 - *Plant Anatomy*. John Wiley and Sons, New York, London, Sydney: 318-337
3. GALEŞ RAMONA CRINA & TOMA C., 2005 - *Histo-anatomical data of some Euphorbia species from the Romanian flora* (in press)
4. GALEŞ RAMONA CRINA & TOMA, C. 2006 [a] - *Morfologia şi distribuţia laticiferelor în organele vegetative ale unor specii de Euphorbia din flora României*. Lucr. Şt. Univ. Şt. Agr. şi Med. Vet. „Ion Ionescu de la Brad" , Iaşi, ser. Hortic., 1, 49: 21-26
5. GALEŞ RAMONA CRINA & TOMA C. 2006 [b] - *Anatomical structure of some Euphorbia species from the Romanian flora (in press).*
6. GALEŞ RAMONA CRINA & TOMA C. 2006 [c] - *Date referitoare la morfologia şi distribuţia laticiferelor în organele vegetative ale unor specii de Euphorbia L. din flora României (in press.*
7. GALEŞ RAMONA CRINA & TOMA C. 2006 [d] – *Histo-anatomical researches regarding some Euphorbia species from the Romanian flora. (in press).*
8. GALEŞ RAMONA CRINA & TOMA C. 2006 [e] - *Comparative anatomy of the vegetative organs of some Euphorbia species (Euphorbiaceae Juss.) from the Romanian flora (in press).*
9. GAUCHER L., 1902 – *Recherches anatomique sur les Euphorbiacées*. Ann. des Sci. Nat., sér. Bot., 15: 161-309
10. GRINŢESCU I., 1985 - *Botanica* (ed.2), Ed. şt. şi encicl., Bucureşti
11. IVĂNESCU LĂCRĂMIOARA & TOMA C., 2003 - *Influenţa poluării atmosferice asupra structurii plantelor*. Ed. Fundaţiei "Andrei Şaguna", Constanţa
12. METCALFE C. R. & CHALK L., 1972 - *Anatomy of the Dicotyledons*. T II, Clarendon Press, Oxford.
13. PRODAN I., 1953 - *Euphorbia* L. În *Flora R.P. Române*, 2, Ed. Acad. Rom., Bucureşti: 296-367
14. ROTARI RAMONA CRINA, 2004 - *Contribution to the anatomical study of some Euphorbia species from the Romanian flora*. *Lucr. Şt. Univ. Şt. Agr. şi Med. Vet. „Ion Ionescu de la Brad"*, Iaşi, ser. Agron., 47: 72-80
15. ROTARI, RAMONA CRINA & TOMA C., 2004 - *Structural characteristics of some Euphorbia species from the Romanian flora (in press).*
16. ŞERBĂNESCU-JITARIU GABRIELA & TOMA C., 1980 - *Morfologia şi anatomia plantelor*. Ed. did. şi ped., Bucureşti.
17. TOMA C. & GOSTIN IRINA, 2000 - *Histologie vegetală*. Ed. Junimea, Iaşi
18. TUDOSE MIHAELA IONELA, 2001 - *Cercetări morfo-anatomice şi citogenetice asupra unor plante arenarii*. Teză de doctorat, Univ. "Al .I. Cuza", Iaşi

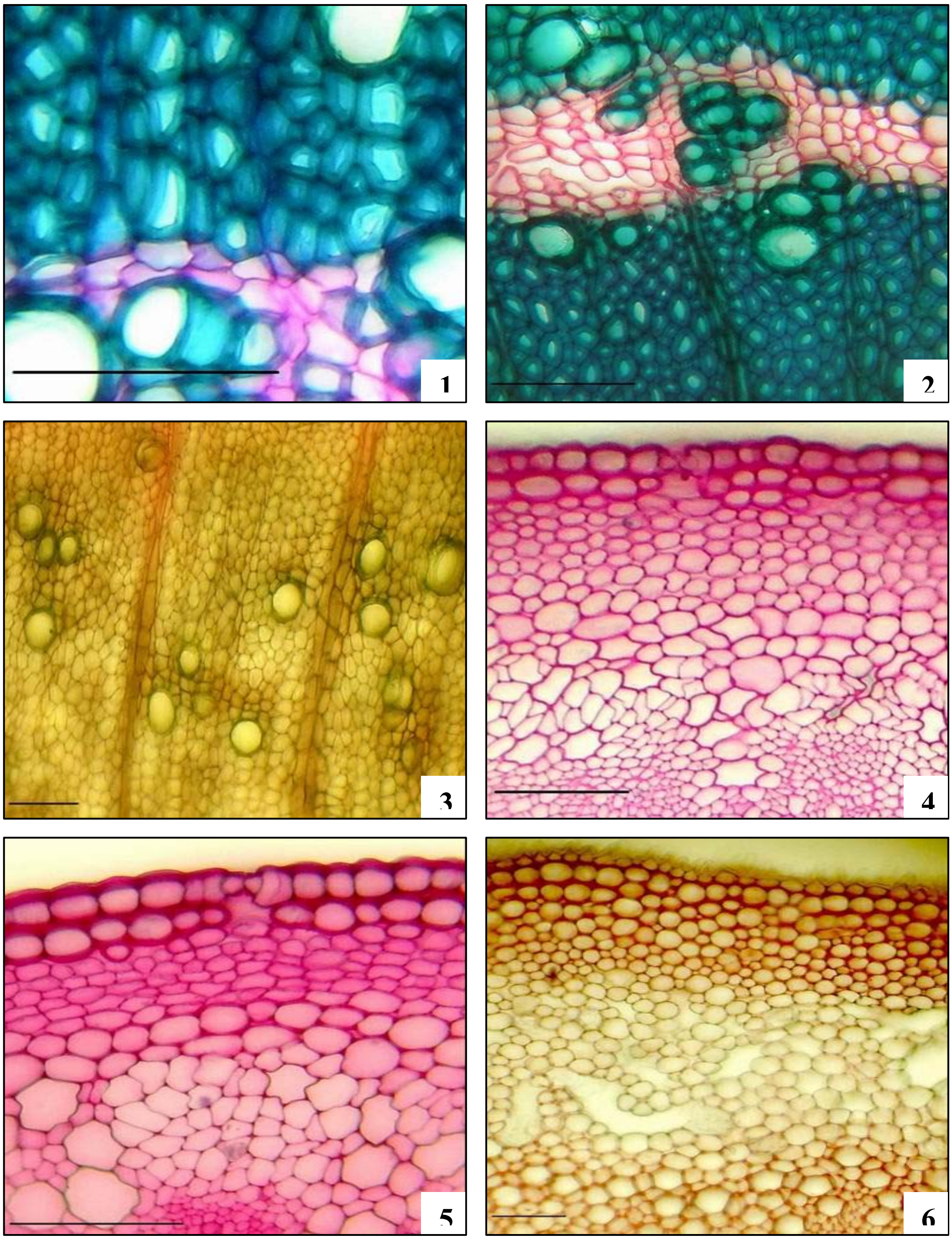

Fig. 1-6. (orig. photos) **1.** Crossection from the *E. angustifrons* rhizome. **2.** Crossection from the *E. seguieriana* rhizome. **3.** Crossection from the *E. glareosa* rhizome. **4.** Crossection from the *E. angustifrons* aerial stem (upper level). **5.** Crossection from the *E. seguieriana* aerial stem (upper level). **6.** Crossection from the *E. glareosa* aerial stem (upper level). scale bars= 50µm

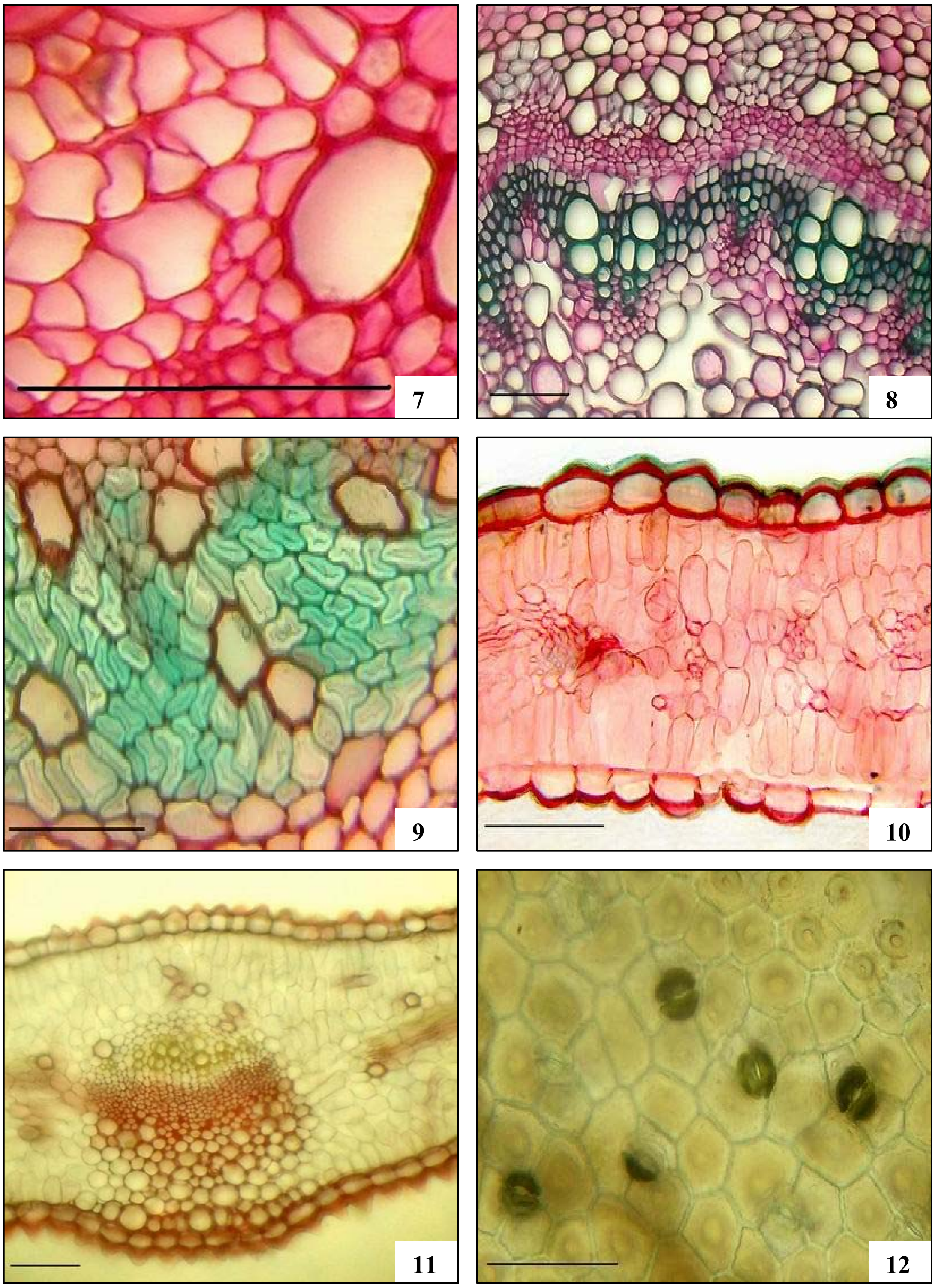

Fig. 7-12. (orig. photos) **7.** Crossection from the *E. seguieriana* aerial stem (upper level). **8.** Crossection from the *E. seguieriana* aerial stem (middle level).**9.** Crossection from the *E. glareosa* aerial stem (middle level). **10.** Crossection from the *E. seguieriana* foliar limb. **11.** Crossection from the *E. glareosa* foliar limb. **12.** Surface section from the *E. glareosa*foliar limb (abaxial side). scale bars= 50μm

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EVIDENCING THE SUCCESIVE CAMBIA PHENOMENON ON SOME HALOPHYLOUS REPRESENTATIVES AMONG *CHENOPODIACEAE* AND ITS POSSIBLE ECOLOGICAL-ADAPTIVE IMPLICATIONS

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ABSTRACT

GRIGORE M. N., TOMA C., 2006 – Evidencing the succesive cambia phenomenon on some halophylous representatives among *Chenopodiaceae* and its possible ecological-adaptative implications. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 87-93.

In this study, authors investigated the axial vegetative organs of four halophytes, belonging to *Chenopodiaceae* family, evidencing the successive cambia in their structure.

Key words: halophytes, succesive cambia, strategies, ecology, adaptations

Introduction

A plant is an opened biological system, that (due to its subsystems, i. e. its histo-anatomical features) might provide data on certain physico-chemical particularities on the environment. Successive cambia, met within halophytes as the *Chenopodiaceae*, is considered by most researchers a structural anomaly (Hérail, 1885; Metcalfe and Chalk, 1972; Şerbănescu-Jitariu and Toma, 1980; Fahn and Zimmerman, 1982); it affects axial vegetative organs, which are the root and the stem.

Any histo-anatomical features must be considered, at least theoretically and hypothetically, an adaptive one, even if one shouldn’t assert that everyone of them has the same importance or relevance in proving a plant’s belonging to a certain ecological group. The adaptive-evolutive process had taken place over the long and shaping influence of the environmental agents, among which we are interested in the high salinity of the soil as having a major impact, but also in the soil moisture. They both have therefore formative abilities on halophytes. However we must look at these ambiental elements as stress-agents that have affected, during the ages and presently on the halophytes structures. Their action has accompanied the halophytes evolution, as an active, dynamic component of the evolutive “adventure”. The stress issue about the plants is a most actual and attractive problem, a tendency to better understand the particular ways in which a plant reacts at the environment’s requirements.

Excessive salinity of soil affects a lot of aspects concerning the halophyte’s metabolism and it also induces histo-anatomical changes. Scientists still argue on the question whether all these remain just adaptations which increase the plants chances to tolerating and overcoming the salt stress or maybe they are symptoms of harming and altering the equilibrium which maintains the vital process (Poljakkof-Mayber, Gale, 1975). The answer of this question, even if it looks like a problem of biosemiotics established between a plant and the environment, however has in common the specific reaction of the vegetal organism which has a molecular nature, i. e. membrane one. But, according to the General Systems Theory, the histo-anatomical changes include the former hierarchical levels: molecules-membranes-cells-tissues-organs.

Supernumerary cambia refers to vegetative axial organs (the root and the stem) and it consists shortly of the following succession of histological events: the typical, general structure is generated by a normal cambium that generally produces a few secondary phloemic and xylemic vessels. Afterwards, on behalf of the pericycle an additional (supernumerary) cambium is born, this one providing a ring of fundamental cellulosic parenchyma, where the vascular bundles are placed circularly, with the phloem outside and the xylem inside. Each normal cambium is born after that from the phloemic parenchyma produced by the former cambium (Kishore S. Rajput and Karumachi S. Rao, 1999).

However there is no uniform model to govern successive cambia. The first supernumerary cambium may be born in the primary phloemic parenchyma

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area, between the pericycle and the secondary phloem (Hayward, 1938).

The forming of the rings, the activation of the secondary successive cambia formation is a progressing, centrifugal process. Moreover, the author mentioned above suggests that the particular way in which the vascular elements are distributed implies the fact that those secondary cambia do not appear as complete rings, but consist of discrete sectors, derived from the pericycle.

Yet, how did those cambia appear? And especially,why?

We have tried to offer a possible answer by extending this matter to a larger field, one linked with the issue of halophyte's reaction to the salt stress. The plants react to a stressing agent, by means of a complex mechanism, implying a receptive structure which proves sensitive to the agent. The plant's answer is mediated by signals transmitted by phytohormones, among which the abscisic acid (ABA) is the most implicated element in the mechanism of stress for plants (Schulze, 2001; Bray, 2001; Syed Shamshod Medhi Naqvi, 2001). In this stress conditions, the ABA concentration in plants increases itself (Ungar, 1991) determining among others a decrease of growth and a reduced transpiration. This limitation in growth and development allows the plant to accumulate energy and resources to fight against stress, before its effects will endanger the plant's existence. It looks like an adaptive-evolutive strategy, as this hormonal mediation allows a high plasticity of the organs of growth (the root and the stem) and a better reconciling with the environment agents.

As with successive cambia and the quantifying of cambial production, the abscisic acid's role remains obscure and inconclusive. It may reduce the xilemic production and the enlarging of the xilemic cells, during summer time. An important amount of ABA may be present in the cambial area in autumn, after a drought stress and in spring, at young growing stems. Therefore, the mediating activity of ABA, even if it is the main hormone involved with the plant's reactions against stress, seem to be seasonal, that's why we plead for its distribution in the most alkaline compartments (Lachaud Suzanne, 1989).

Material and method

The material consists of 4 taxa, which belong to *Chenopodiaceae* family: *Atriplex littoralis* L., *Atriplex prostrata* Boucher ex. D.C., *Halimione verrucifera* (Bieb.) Aellen and *Petrosimonia triandra* (Pallas) Simonkai. The material subjected to analysis (the axial vegetative organs of the plants) has been fixed and preserved in 70% ethylic alcohol. The sections (at the inferior, middle and superior level of the root and stem) were cut with microtome, subsequently colored with iodine green and alaun-carmine, then mounted in gel and analyzed in a Novex (Holland) light microscope. The light micrographs were performed by means of Novex (Holland) microscope using Canon A95 camera.

Results and discussions

Atriplex littoralis L.

The root (Fig.1)

In the inferior level, the central cylinder has a number of 3-4 rings of conductive tissues, as a result of supernumerary cambia, each of them having the thick xylem inside and the phloem outside, much thinner.

At any ring, the xylem is all sclerified and lignified, having quite a few irregularly dispersed vessels; the xylemic fibers that dominate the xylemic structure have a strong, thickened architecture, moderately lignified. The phloem consists of sieved tubes, companion cells and phloemic parenchyma. The latter of the conductive tissue is yet to be formed, being unequal as thickness in the root girth.

In the intermediary level, the general structure has the same stages with the same concentric conductive rings number. The xylemic vessels in the axial part have a smaller diameter, but more lignified walls. The libriform fibers have extremely thick walls, but only part lignified.

Towards the superior level, the root is thicker, its structure containing 5 (6) concentric rings of conductive tissue, the phloem being no longer present as continuous ring, but as discontinuous rings surrounded by xylem; the latter is highly sclerified and lignified, with the libriform prevailing.

The stem (Fig. 2)

In its superior level, the structure continues to be normal, fact evidenced by Metcalfe and Chalk (1972), they signalling that the phenomenon affects on the species relatively slim-thick, but sometimes was yet observed in the higher part of the stem and at all observed thin root species. At this level, the central cylinder consists of a high (14-16) number of phloemic-xylemic vascular bundles of different size-the wide collateral type; the larger bundles prevail deep in the pith.

The middle level contains, along with the vascular bundles, a thick libriform ring in which are located numerous bundles of xylemic vessels and "island" of phloemic elements outwards. The libriform isles have visible colenchymatized elements and towards the exterior one can observe rows of thick-wall yet cellulosic sclerenchymatic fibers.

Supernumerary cambium, which is the starting point for the phloem and the xylem mentioned above, is continuous and multistratified.

To the organ base, in the central cylinder, as a result of the supernumerary cambia, 3-4 concentric conductive tissues have appeared, the phloem appearing as isles completely surrounded by xylemic tissues. The bundle type structure, seen at the former levels is no longer so visible. The libriform is more sclerified and lignified, xilemic vessels are spread on irregular basis, and the initial primary structure bundles are completely poked in the parenchymatic-cellulosic pith.

Atriplex prostrata Boucher ex D.C.

The root (Fig. 3)

In the inferior level of the organ, the primary structure is often of diarchic type, and on the first ring of fundamental parenchyma- result of the supernumerary cambium- the vessels are disposed on irregular basis, large on diameter, and the vessels are medium thick and lignified; among the vessels, xylemic parenchyma have cellulosic walls and the libriform is represented by moderate thick and lignified-wall fibers. Step by step, a secondary supernumerary cambium is formed, and it produces a pretty compact xylemic ring inwards and a phloemic one outwards. In the xylemic ring prevails the libriform, parenchymatic cells being rare, as well as the vessels; the latter have unequal diameter and are disposed on irregular basis. The phloem ring consists of sieved tubes, companion cells and phloemic parenchyma.

In the middle level of the root there are four xylemic rings to be seen and also four phloemic rings, the general structure being a (non) symmetrical one, on one face of the structure one can see only two xylemic and two phloemic rings. All xylemic rings are highly lignified, the libriform prevails and the vessels are disposed on irregular basis. The phloemic rings are completely cellulosic, with vascular phloem (sieved tubes and companion cells) in separation of the phloemic parenchyma. Here and there, cellulosic parenchymatic rays are getting through the xylemic rings and in the phloemic rings interfere the strips of lignified walls elements.

In the superior level, we could evidence 6-7 concentric xylem rings totally lignified, separated by an equal number of phloemic rings completely cellulosic. The xylemic and phloemic rings are more sinuous, different in thickness, here and there interrupted or in touch with the other. In the central level, xylemic tissue prevails, the phloem being present as small islands completely surrounded by thickened and lignified-wall elements, the same situation being observed to the outwards of the root, where cellulosic phloemic rings are interrupted of radial lignified tissue stripes.

The center of the organ is made mostly of a compact, massive xylem, highly lignified, having on each side two visible colenchymatized phloemic bundles.

The stem (Fig. 4)

On this species, the superior and the middle part of the organ have a normal structure, while the inferior level is of successive cambia resulting a large number (3-4) of xylemic-phloemic concentric rings. The xylem rings are always very thick and the phloemic ones are thinner, having vascular phloemic isles separated by cellulosic parenchymatic cells.

Halimione verrucifera

The root (Fig. 5)

In the lower (inferior) level, the central cylinder has a structure common to the *Chenopodiaceae* family, the structure being mostly the result of supernumerary cambia activity.

A completely sclerified and lignified xylemic massive occupies the root axe, in which can be observed three radiant primary xylemic vessels, positioned on one single row; we may consider that, beyond these blades, the primary structure is of triarchic type.

This compact central xylemic solid is surrounded by three radiant primary xylemic blades and separated from cellulosic parenchyma elements.

Next there appear two xylemic rings, resulted from successive cambia's activities, ring that are separated by phloemic areas, totally cellulosic, coming up because of the same successive cambia's activity.

The xylemic rings are highly sclerified and lignified and they are dominantly libriform, and the vessels have different diameter; often, these vessels are grouped together and next to them, peripherically, we can find islands of phloem separated by radial areas, made of sclerified and lignified elements.

The second ring (the external one) is xylemic and it is still in process and forming, having just a few vessels and at the exterior part the cambium has produced less phloemic elements.

To the middle level, the general structure is still the same, with the only difference of having formed the second discontinuous phloemic ring (isle-like shaped), surrounded externally by the phloem coming from the third ring.

As with the former level, the stel's central part has a slightly trilobate aspect, coming up from the xylem superposed to the 3 phloemic bundles.

At the inferior level, we must notice that the second phloemic discontinuous ring (isle-like shaped) had been formed, surrounded externally by the xylem from the third ring. As with the former level, the central part has a slightly trilobate aspect, coming from the xylem superposed to the three phloemic bundles.

The stem (Fig. 6)

The central cylinder, in the superior level, has many (8) vascular bundles, having various size and having the most part of the phloem and xylem of primary origin; next to the phloem, the xylemic vessels are separated by a few libriform elements.

Peripherically of the vascular bundles and between them, there is a sclerenchymatic tissue which creates a thick ring, whose cells have extremely thickened walls, intensively lignified. This way, the phloem of vascular bundles appears as "isles" completely surrounded by lignified and sclerified tissue. At the extremity of the sclerenchymatic ring we can notice the first supernumerary cambium (of peryciclical origin), which has created xylemic vessels here and there, to the inside part, and some more phloemic elements to the outside part. These phloemic elements, together with the cambium form a merely continuous ring.

Differently from the former analyzed level, the central cylinder from the central region of the stem, is thicker, having a thick ring of fundamental parenchyma, highly sclerified and lignified, and a pith that has 8 vascular bundles from the normal, primary structure, that are dominant.

In the sclerified and lignified ring, here and there we can see xylemic vessels, irregulary disposed, often forming radial discontinuous lines; each of this line has an isle of phloemic tissue at the exterior.

The first line of xylemic vessel, together with the corresponding island (calotte) make a thick ring of 'bundles' straight into the fundamental mass of libriform. The second bundle ring is thinner and it also has the phloemic isles (the calottes) surrounded by sclerenchymatic tissue, highly lignified. Here and there, at the internal side of the primary cortex we can notice a few sclerenchymatical cells, solitary ones, located at the exterior side of the last ring (which is in the process of forming) of supernumerary cambium and a few phloemic elements, formed sometime later than the rest.

Finally, the central cylinder is thicker in the inferior level than in the rest of the former analyzed levels, having 4-5 rings of phloemic isles, cellulosic, actually corresponding, together with the internal side xylem, to those rings of collateral vascular bundles, which stand straight into the fundamental mass of libriform, extremely sclerified and lignified.

Petrosimonia triandra

The root (Fig. 7)

In the general structure of the inferior level, there are to be distinguished 6-7 concentric rings of conductive tissues, coming from the successive cambia area's activity. There is a big quantity of libriform, a reduced number of xylemic vessels, irregularly spread and numerous thin tangential bands of phloemic tissue, marking the place and the number of the vascular bundles that had been born by the supernumerary cambia's activity.

All the mechanical sclerenchymatic elements have an extremely thick wall and most of it is highly lignified.

In the central part of the root, at a middle level, we can still distinguish the primary structure, diarchic type, and a quite homogenous structure follows, represented by many concentrically areas of vascular bundles among which there are sclerified and lignified rays. The xylemic vessels from the primary structure have small diameter, and the walls are highly lignified; the xylemic vessels from the vascular bundles that come from the successive cambia activity have bigger diameter and the wall is very thick but very slightly lignified; they are irregularly spread and they have a big amount of libriform between them.

The phloem belonging to the vascular bundles makes thin tangential bands, interrupted here and there by narrow rows of mechanical cells, with highly thickened and moderately lignified walls, as those from the libriform fibers, to the xylemic structure.

At the cut level, we can observe approximately 4 concentrically rings of vascular bundles, coming from the activity of 4 succesive cambia.

The stem (Fig. 8)

At the superior level, the central cylinder has some (5-7) vascular bundles, of different size, separated by medullary cellulosic-parenchymatic rays.

All the vascular bundles have the phloem made of sieved tubes and companion cells and the xylem made of radial rows of vessels separated by cellulosic parenchymatic cells; therefore, the structure is primary.

At the exterior of these vascular bundles, the first supernumerary cambia had appeared, being of pericycle origin. It starts functioning bifacial, providing xylem at the interior part and phloem at the exterior. The process of tracheogenesis is in progress and some xylemic vessels have very thin cellulosic walls.

It's important to say that the first supernumerary cambia forms a continuous ring, multilayered, which will produce vascular bundles and, here and there, medullary rays.

At the middle level, besides the primary and the secondary structure we are able to describe a structure coming from the successive cambia activity, characterized by a huge amount of highly sclerified, but less lignified libriform, where xylemic vessels are dispersed irregularly. At the exterior of this thick ring of xylem, we cam observe a thin ring of phloemic elements. We have to mention that some authors still use the mane of *tertiary structure* for all the supernumerary cambia productions (Hayward, 1967; Şerbănescu-Jitariu and Toma, 1980).

Towards the inferior level, the structure is the same, with the difference of having a thicker central cylinder, containing a big amount of libriform, rather few xylemic vessels, irregularly dispersed or forming radial discontinuous rows and a few little isles of phloemic tissue.

Conclusions

The successive cambia affects the axial vegetative organs (the root and the stem) of all halophytes species studied. Nevertheless, at *Atriplex prostrata* the stem has a normal structure at the middle and superior levels, but at *Atriplex littoralis* the structure is normal only at the superior level. As for the xylemic vessels, they are generally irregularly dispersed through the fundamental parenchyma, they are just a few and have small diameter in the root and the stem of *Atriplex littoralis*, while the phloem has an isle-like aspect.

In the root of *Atriplex prostrata*, the xylemic vessels have, generally, a big size and they are irregularly dispersed, the phloem having a relative ring-like form as the xylem. Here and there, these rings might be discontinuous.

As for *Halimione verrucifera* the root affected by supernumerary cambia has phloem and xylem as rings that might, sometimes, be discontinuous.

At *Petrosimonia triandra*, in the root, the xylem has, generally, a big diameter and the phloem makes thin tangential bands.

We underlined, with no exception, big amount of libriform having thick lignified walls. The massive lignification in the stell met with species affected by successive cambia may by induced by the soil's excessive salinity (Bickenbach, 1932 cit. by Waisel, 1972). Kozlowski (1997) underlines that salinity raises the amount of fiber productions. According to the same context of plants adaptations at the environmental stress (Bohnert, Nelson, Jensen, 1995) it is already known that each plant reacts by the way of the metabolic changes mediated on the same hormonal way. It won't be impossible to see the lignin is such a metabolically answer, which may contribute, among others, to the increasing of the cell walls' resistance at osmotic high pressure, so necessary to exceed the soil's one.

Concerning to the adaptive-ecological meaning of the plant, the successive cambia in halophytes could be related to the shaping environmental agents. So, we consider some certain mechanisms that adjust the salt content. One of them is the dilution of salt through growing (Greenway and Thomas, 1965 cit. by R. Albert, 1975), another refers to salt retaining in root and stem (Black, 1956; Eshel and Waisel, 1965; Jacoby, 1964, 1965, cit. by R. Albert, 1975), and also the retransportation of salts into the root and their elimination through environment (Willert, 1968; Cooil et al, 1965, cit. by R. Albert, 1975). All these might be related with an internal large surface, if we just consider the high ability to retaining the saline water in the root and the stem.

On the other hand, the cork from the external part of the root could delay the water absorption. So, the salts get harder through the root, but once they got there, they get spread within this enlarged surface. It might happen that water distribution to the rest of the plant would be literally "delayed". The enlargement of the surface would inevitably mean a dispersion place for salts, which are in the same time diluted, being finally less harmful.

Undoubtfully, the number and diameter of xylemic vessels may play a good part in this mechanism. For this reason, we may regard the successive cambia by its effects (many vessels, high "internal" surface) as a beneficial "compromise" for the plant, somehow between the necessity of limiting the growth (controlled by ABA) and the necessity of imposing a salt's dilution strategy in the plant organism, less in the stem superior levels. The top of the stem, as a growth region, would therefore be protected from the harmful effects of salt, as we all know that young tissues are more sensitive to salt.

Considering the plant's adaptations to the environmental agents, both as structural changes more or less evident, and as individualized, particular answers, to consider successive cambia a structural anomaly seems to us, somehow, inadequate and we believe that using this term must be reconsidered.

Rezumat

Autorii au investigat din punct de vedere histo-anatomic organele vegetative axiale (rădăcină, tulpină) la 4 specii de halofite din familia *Chenopodiaceae*, la care s-a pus în evidență fenomenul de policambie. S-a încercat să se coreleze această structură cu posibilele sale implicații ecologice, adaptative.

References

1. BOHNERT H.J., NELSON D.E., JENSEN G.R., 1995 - *Adaptations to environmental stresses*. Plant Cell, 7: 1099-1111
2. BRAY E.A., 2001 - *Regulation of gene expresion during abiotic stresses and the role of the plant hormone abscisic acid. In.Handbook of plant crop physiology*. Second ed. Revised and expanded, ed. by Mohammad Pessarakli, Marcel Dekker, Inc. New York, Basel

3. FAHN A., ZIMMERMANN M.H., 1982 - *Development of the succesive cambia in Atriplex halimus* (*Chenopodiaceae*) (abstract). Bot.Gaz., 143 (3):353-357
4. HAYWARD H.E., 1938 - *The structure of economic plants*. Macmillan Co. New York
5. HÉRAIL J., 1885- *Etude de la tige de Dicotylédones*. Ann. Sci. Nat., Bot., sér. 7, 12: 203-314
6. KISHORE S.RAJPUT, KARUMANCHI S. RAO, 1999 - *Structural and developmental studies on cambial variant in Pupalia lappacea* (*Amaranthaceae*). Ann. Bot. Fennici, 36: 137-141
7. KOZLOWSKI T.T., 1997 - *Response of woody plants to flooding and salinity*. The Physiology Monograph, **1**: 1-29
8. LAUCHAD SUZANNE, 1989 - *Participation of auxin and abscisic acid in the regulation of seasonal variation in cambial activity and xylogenesis*. (abstract). Trees-Structure and Function, 3(3): 125-13
9. METCALFE C.R., CHALK L., 1972 - *Anatomy of the Dicotyledons*. Clarendon Press, Oxford, **2:** 1075-1084
10. NAQVI S.S.M., 2001 - *Plant growth hormones: growth promotors and inhibitors*. *In. Handbook of plant crop physiology*. Second ed. Revised and expanded, ed. by Mohammad Pessarakli, Marcel Dekker, Inc. New York, Basel
11. POLJAKOFF-MAYBER A., GALE J., 1975 - *Plants in saline environments.* Springer-Verlag, Berlin, Heidelberg , New York
12. ROLAND ALBERT, 1975 - *Salt regulation in halophytes*. Oecologia (Berlin), **21**: 57-71
13. SCHULZE E.-D., BECK E., MÜLLER-HOHENSTEIN KLAUS, 2005 - *Plant Ecology*. Springer- Verlag Berlin, Heidelberg
14. ŞERBĂNESCU-JITARIU G., TOMA C., 1980 - *Morfologia şi anatomia plantelor*. Ed. Did. şi Ped., Bucureşti
15. UNGAR I.A., 1991 - *Ecophysiology of vascular halophytes*. CRC Press, Inc, Boca Raton
16. WAISEL YOAV, 1972 - *Biology of halophytes*. Academic Press, New York, London

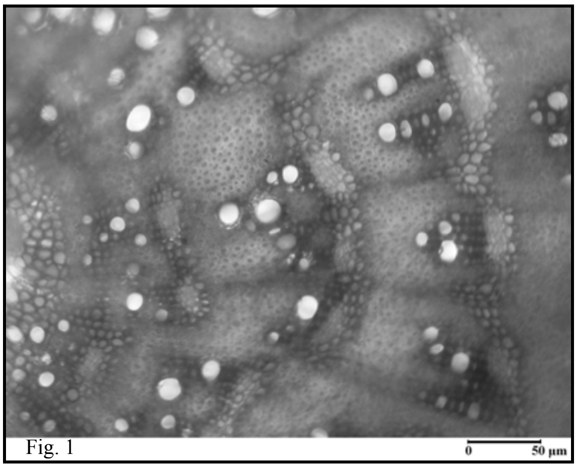

Fig. 1

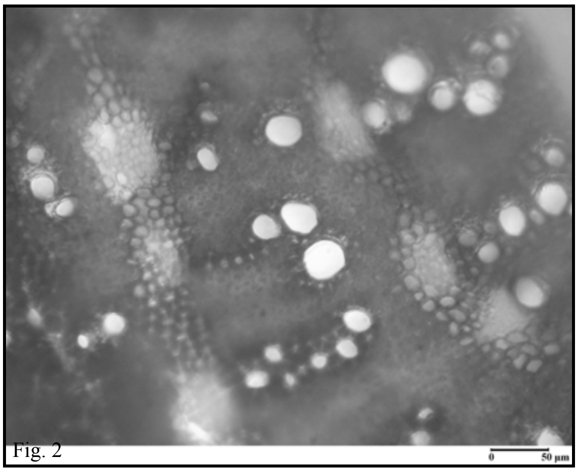

Fig. 2

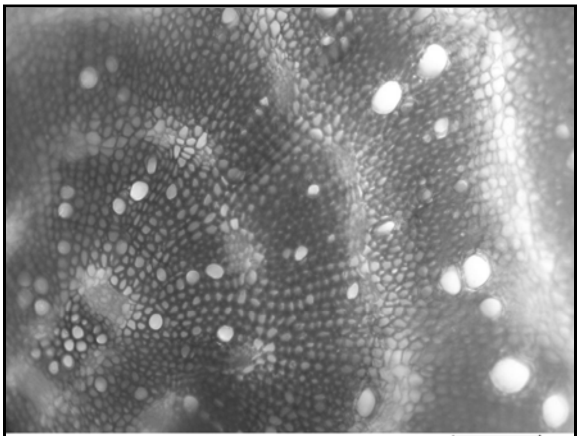

Fig. 3 — 0 50 µm

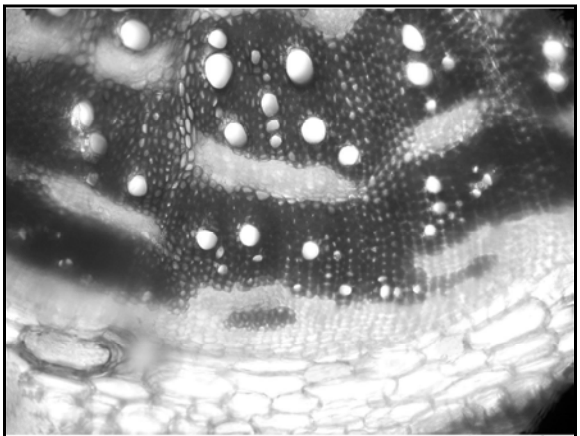

Fig. 4 — 0 50 µm

Cross section: ***Atriplex littoralis***- root (Fig. 1) and stem (Fig. 2). ***Atriplex prostrata***-root (Fig. 3) and stem (Fig. 4)

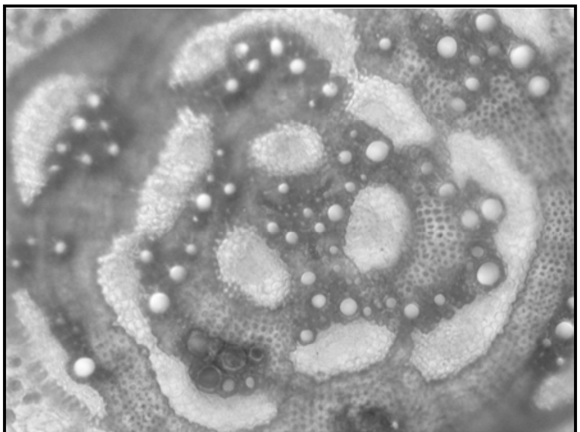

Fig.5 — 0 50 µm

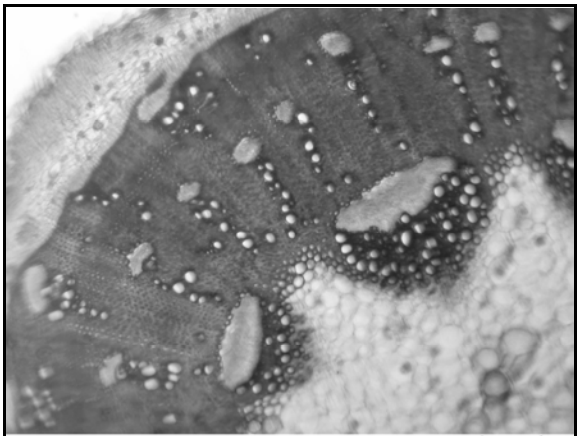

Fig. 6 — 0 100 µm

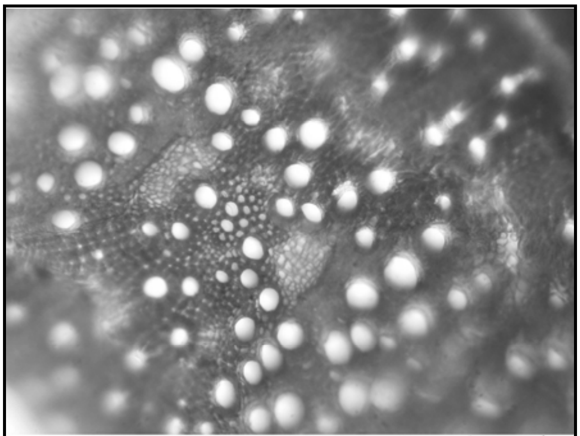

Fig. 7 — 0 50 µm

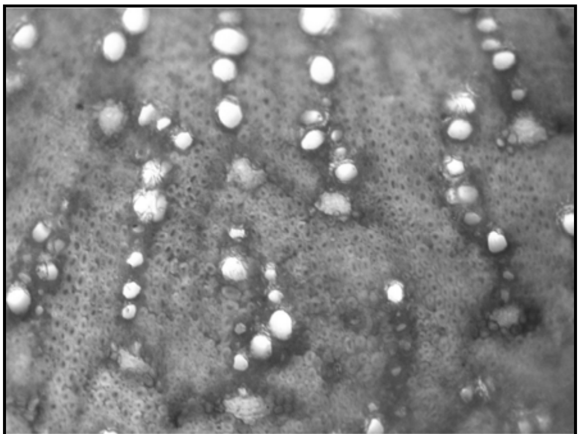

Fig. 8 — 0 50 µm

Cross section : ***Halimione verrucifera*** - root (Fig.5) and stem (Fig.6). ***Petrosimonia triandra*** – root (Fig. 7) and stem (Fig. 8)

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ECOLOGICAL ANATOMY ELEMENTS RELATED TO *ASTERACEAE* HALOPHYTES SPECIES

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ABSTRACT

GRIGORE M. N., TOMA C., 2006 – Ecological anatomy elements related to Asteraceae halophytes species. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 94-98.

In this study, authors investigated the vegetative organs of three halophytes, belonging to *Asteraceae* family, underlying some features with ecological significance.

Key words: halophytes, strategies, ecology, adaptations

Introduction

A plant by its constitutive adaptations includes in a particular manner, the environment agents' influence, "processes" an ambiental elements on quality and quantity and therefore gives an adaptative answer which suggests, in some measure, that a histo-anatomical feature is the combined and bug-timed active answer of the environment. The halophytes, due to their morphological, but mostly histo-anatomical features, may be considered indicators for the saline soils. The salt stress produces to halophytes histo-anatomical changes that can be observed at different levels and adequate interpreted. As a sequel of our studies (Grigore and Toma, 2005) this material presents some histo-anatomical data referring to some *Asteraceae* halophyte species.

Material and method

The next taxa of *Asteraceae* family were considered: *Artemisia santonica* L., *Aster tripolium* L. ssp *pannonicus* (Jacq) Soo and *Lactuca saligna* L.; the first two were collected from Cotnari (Iasi), the latter from Crasna (Vaslui). For the purpose of investigation, the material was fixed and preserved in 70° ethylic alcohol. The cross section of the vegetative organs was made using a manual microtome and a botanic razor. The resulted sections were subjected to the "classical" steps of histo-anatomical investigations: 20-30 minutes of sodium hypoclorite, washing with acetic water, then water, then, for one minute coloring with iodine green, wash in 90° ethylic alcohol, coloring with carmine red for 20 minutes, water wash and finally glycerol-gelatine fixing. Once the permanent materials were obtained, micrographs were taken, using a Canon A95 camera and (Holland) light microscope.

Results and discussions

This report will insist mostly on some histo-anatomical features which we consider to be more revealing on the adaptivity of the plants to the soil salinity. Anyway, that does not mean that the other features are not relevant for one species or another, but just the fact that different parts of the entire have different values in the clarifying the whole structure. Therefore, as a consequence of the investigations, we could observe at the axial vegetative organs (root, rhizome, stem) that the typical secondary structure is common for *Artemisia santonica*'s root and stem , for *Aster tripolium*'s rhizome, root and stem (especially in the middle and inferior level) as well as for (partially) *Lactuca saligna*'s root and stem. At the same time we note that the two secondary meristems intervention in clarifying the secundary structure may be different for various organs.

A commun histo-anatomical adaptation for *Artemisia santonica* and *Aster tripolium* ssp *pannonicus* consists of aeriferous cavities. We could evidence them in the cortical parenchyma among the root's inferior level of *Artemisia santonica* (Fig. 1 and 2) and especially in *Aster tripolium* ssp *pannonicus*'s rhizome, root and stem (Fig. 4, 5 and 6). These are common features for more halophyte species as *Juncus* and *Spartina* (Waisel, 1972; Anderson, 1974); the authors presume it is a feature of the older plants cortex. A similar situation is suggested in the case of mangroves; in this case, the stem cortex of the old plants turns in being used as aeriferous tissue, and these tissues become more developed in the lower level of the stem (Mullan,

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1932 quoted by Waisel, 1972). It might be a convergence, for the fact that plants which have in common salinity and moisture as combined ecological agents, could develop similar adaptive strategies. We believe that the existence and the role of these aeriferous lacuna are in agreement with the local environment agents. It is known that a saline soil has a defectuous ventilation and water circulation- when it is moist becomes marshy, and when it is dry it clops (Davidescu, Calancea, Davidescu, Lixandru, Țârdea, 1981). Whether it is dry or moist, a salt marsh offers basically similar conditions for the plants in terms of effects on them. In both cases, the plants suffer from a "physiological drought" because Na^+ is more hydrative than other ions, which explains why the water retaining is higher even if the salin soil is moist. That's why, always, at least partly, a salt stress is a drought stress and vice versa. Moreover, sodium and chloride are biologically "aggressive osmolytes" inducing, due to their features, a triple stress: salt, ionic and a dehydratation one (Schultze, 2001), but the clearely presence of the aerenchyma, at least at *Aster tripolium*, can be explained through the fact that it is a halophyte of moist salt marsh (Prodan, 1922, 1939; Bucur, 1960; Şerbănescu, 1965) in which can occure a flooding condition, which is followed by another component of the global stress- the hypoxia conditions that can have an effect over the subterraneous parts of the plant. The aerenchyma is better developed on the plants living in flooding places than on those living on better aired habitats (Waisel, 1972). The plants subjected to flooding conditions are exposed to hypoxia and even anoxia and make oxygen storage in the roots or stems (Kozlowski, 1997; Schulze, 2001). Hypoxia produces negative redox potential of the soil, and in the end, the pH shifts into the alkaline range (Schulze, 2001). Along all these processes, the ethylene intervens too, as a phitohormone involved in the plant's reaction to stress. This induces, via so called "programmed cell death" (PCD) (Schulze, 2001) the formation of aerenchyma – the histologically expressed by the cells sepparation and desintegration, followed by the enlargement of the spaces among the collapsed cells (Esau, 1965). The whole subtil and complex mechanism is, not, of course, completelly understood yet. That is an additional proof for the fact that the environmental agents influence is conjugated, multifactorial and quite hard to view in its entire complexity.

We could also evidenciate the existence of a primary endodermis, the cells highly prolongated tangentially, with the Casparian strips in the radiary walls being visible. All these are present in the *Artemisia santonica* root (Fig.1, 2 and 3) and stem, in the *Aster tripolium* rhizome and the *Lactuca saligna* stem. Regarding the presence and the relative development of Casparian strips, those appear not to be outside ecological signification. Fahn (1964) and Ginzburg (1964) (quoted by Waisel, 1972), studiing especially this aspect of the desertic halophytes, found in their roots, the Casparian strips wide and thick. It was thus suggested that in habitats in which an easy penetration of salts into the plant tops may endange their normal existence, the endodermal barrier appears in a highly developed form. We should say that some authors (Van Andel, 1953; Steward and Sutcliffe, 1959; Weigel and Lüttge, 1962, quoted by Waisel, 1972) suppose that the active transport mechanism resides either in the endodermis or in the xylem parenchyma. As a matter of fact, when it was tried to compare the anatomical features of plants which occur in saline or drought environments with those of the glycophytes, the most important and studied aspect was the thickeness of Casparian strips (Poljakkof- Mayber, Gale, 1975). Casparian bands contain both aliphatic and aromatic suberins (Schreiber *et al*., 1999, quoted by Peng *et al*, 2004), which suggest that the Casparian bands are fairly impermeable to ions and to high molecular weight polar solutes, but may allow some passage of water and small solutes. On certain species, Casparian strips cover almost all the radiary walls of the endodermis, comparing to the less than ¼ cover of these walls of the dicotyledonous glicophytes (Waisel, 1972). This modiffications of the endodermis are related to the ions, to their absorbtion. It is know that K^+ has a major role in the salt tolerance. The "ideal " schema for salt tolerance of halophytes would consist in mentaining a high level of K^+ and a low level of Na^+ in the cells , but these two ions compete against each other. Above many mollecular biology aspects, we mention just the solutions as Na^+, K^+, Ca^+, Mg^+, and ABA (abscisic acid) move freely in the apolpast of root cells and must pass through Casparian strips to reach the apoplast of xilemic vessels.

The relative lignification of central cylinder, pointed on our materials, can be related to an excessive salinity in soil (Bickenbach, 1932, quoted by Waisel, 1972). Kozlowski (1997) underlines that the salinity increasses the fibre production. The lignin may be the cellular resistence element against the high osmotic pressure inside the plant body.

Regarding the structure of the leaf, we can observed that the structure of the lamina of *Aster tripolium* ssp. *pannonicus* is homogenous, or inequal bifacial-heterofacial in its superior level and bifacial-izofacial typically, in its inferior level. The stomata are of various types: anizocytic, tetracytic and anomocytic.The lamina is not verry succulent. The succulence is mostly regarded as a halophylous expression (Chermezon, 1910; Țopa, 1954; Rațiu Flavia, Nicolau Magdalena, 1967), resulted especially from the higher development of the acviferous tissue cells; but we can not strongly conffirm the presence of this halosucculence feature of our species. We believe this must be regarded as a combined result of the environmental agents and can be considered, unless with prudence, as an universal feature of the halophytes. Along that, we must not forget the plant has 2-3 biological forms (Bucur, 1960).

In *Artemisia santonica* we point that all the parenchyma cells (belonging to the hypodermic columns) next to the median bundle and to the perifascicular sheaths represent acviferous elements characteristic to some salt plants (Chermezon, 1910) (Fig. 7 and 8). The plant was, indeed, collected from a dry saline land. As a matter of fact, the reduction of foliar surface, meaning a decrease of transpiration, is also a xeromorphosis feature (Şennikov, 1950). The plant has a large ecological plasticity, growing especially during the summer on dried, salin soils (Bucur, 1960).

Lactuca saligna has a lamina with ecvifacial-bifacial structure. We can observe stomata, with a suprastomatic cavity, little depth (Fig. 9 and 10), stomata which might be related with the dry habitat where the plant grow, this being a xeromorphosis feature. The stomata are anomocitic type.

Conclusions

Following the histo-anatomical investigations of the three taxa, we can make the following assumption with possible ecological implications:

The presence of aerenchyma in the rhizome, root and stem of *Aster tripolium* ssp. *pannonicus* and in the root of *Artemisia santonica* represent a common feature for other halophyte species, being the convergent expression of the more types of stress impact: salt, hypoxic and ionic.

The existence of a primary endodermis in the rhizome of *Aster tripolium* ssp. *pannonicus*, as well as in the root and stem of *Artemisia santonica* and *Lactuca saligna*, which has, as we have just seen, an obvious role in the halophytes resistence to salinity.

The existence of the stomata located under the epidermic cells level in the lamina of *Lactuca saligna* and the perifascicular acviferous cells in the lamina of *Artemisia santonica*, which represent xeromorphosis features of these halophytes.

Concording with all mentioned data, we can conclude that *Aster tripolium* ssp. *pannonicus* is a moist saline (even flooded) soil halophyte, while *Artemisia santonica* and *Lactuca saligna* are drought saline soil species, fact confirmed on field work.

Above all environment agents, different in quantity and quality, having constant effects on a plant (e.g. halophytes) we must consider every histo-anatomical feature as an adaptive answer of the plant, although an expression hard to understand, yet never without an implicit signification.

Rezumat

S-au evidenţiat anumite trăsături adaptative ale halofitelor luate în studiu: aerenchim bine dezvoltat, endodermă cu benzile caspariene bine conturate, la organele subterane, precum şi celule acvifere şi stomate uşor afundate sub linia epidermei, la nivelul frunzei. Acestea sunt corelate cu factorii de mediu: salinitate crescută, umiditate/uscăciune, precum şi condiţii potenţiale de hipoxie a solului.

References

1. BUCUR N., DOBRESCU C., TURCU GH., LIXANDRU GH., TEŞU C., 1960 - *Contribuţii la studiul halofiliei plantelor din păşuni şi fâneţe de sărătură din Depresiunea Jijia-Bahlui (partea a II-a)*. Stud. şi Cerc. (Biol. şi Şt. Agricole), Acad. R.P.R., filiala Iaşi, an. XI, fasc. 2: 333-347
2. CHERMEZON H., 1910 - *Recherches anatomiques sur les plantes littorales*. Ann. Sci. Nat., sér. 6, Bot., tome XX : 117-129, 270-274, 299-307
3. DAVIDESCU D., CALANCEA L., DAVIDESCU VELICIA, LIXANDRU GH., ŢÂRDEA C., 1981 - *Agrochimie*. Edit. Did. şi Ped., Bucureşti
4. ESAU K., 1965 – *Plant anatomy*. (second edition) John Wiley and Sons, New York, London, Sydney
5. GRIGORE M., TOMA C., 2005 - *Contributions to the knowledge of anatomical structure of some halophytes.* I. Stud. Cerc. Şt.biol., Univ.Bacău, 10: 125-128
6. KOZLOWSKI T.T., 1997 - *Response of woody plants to flooding and salinity*. The Physiology Monograph, 1: 1-29
7. PENG YAN-HUI, ZHU YA-FANG, MAO YONG-QIANG, WANG SUO-MIN, SU WEI-AI, TANG ZHANG-CHENG, 2004 - *Alkali grass resists salt stress through high [K^+] and an endodermis barrier to Na^+*. Journ. Exp. Bot., 55 (398): 939-949
8. POLJAKOFF-MAYBER A., GALE J., 1975 - *Plants in saline environments.* Springer Verlag, Berlin, Heidelberg , New York
9. PRODAN I., 1922 - *Oecologia plantelor halofile din România (comparate cu cele din Ungaria şi Şesul Tisei din regatul SHS).* Bul. Inf. Grăd. Bot. şi Muz. Bot. din Cluj, vol. II, nr. 3: 37-52, 69-84, 101-112
10. PRODAN I., 1939 - *Flora pentru detrminarea şi descrierea plantelor ce cresc în România*, vol. II, ediţia a II-a, Ed. Cartea Românească, Cluj: 253-305
11. RAŢIU FLAVIA, NICOLAU MAGDALENA, 1967 - *Contribuţii la cunoaşterea ecologiei unor halofite*. Contrib. Bot., Univ. "Babeş-Bolyai" Cluj-Napoca: 315-321
12. REIMOLD R.J., QUEEN W.M., 1974 - *Ecology of halophytes*. Academic Press, Inc. New York, London.
13. SCHULZE E.-D., BECK E., MÜLLER-HOHENSTEIN KLAUS, 2005 - *Plant Ecology*.Springer Verlag, Berlin, Heidelberg
14. SENNIKOV A.P., 1950 - *Ecologhia rastenij*. Izdat Sovetskaia Nauka, Moskva: 233-250
15. ŞERBĂNESCU I., 1965 - *Asociaţiile halofite din Câmpia Română*. Com. Geol., Instit.

Geol. Şt. Tehn. Şi econ., seria C, Pedologie, nr. 15, Bucureşti: 1-148
16. ŢOPA E., 1954 - *Vegetaţia terenurilor sărate din R.P.R.*, Natura, anul VI, Nr. 1: 57-76
17. WAISEL YOAV, 1972 - *Biology of halophytes*. Academic Press, New York, London

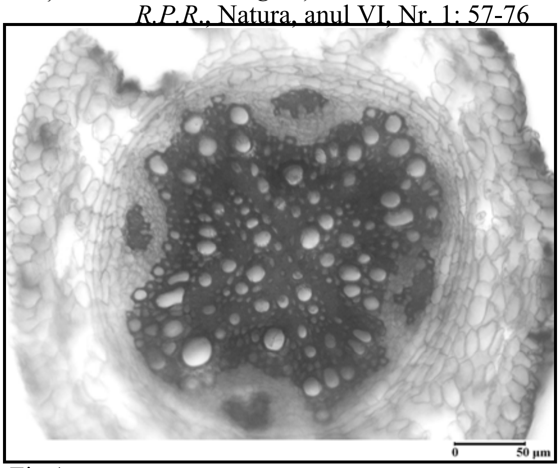
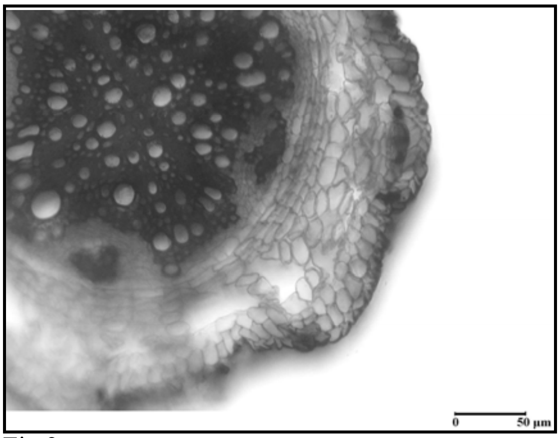


Fig.1



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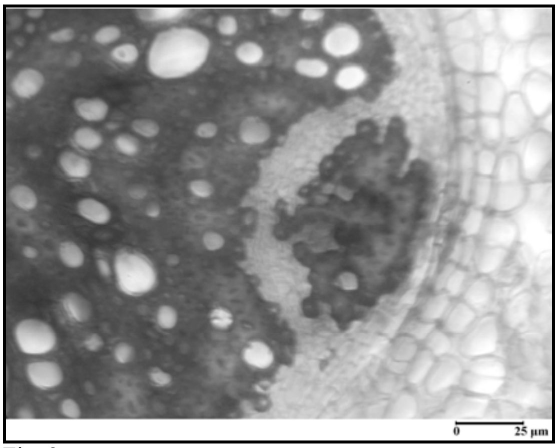

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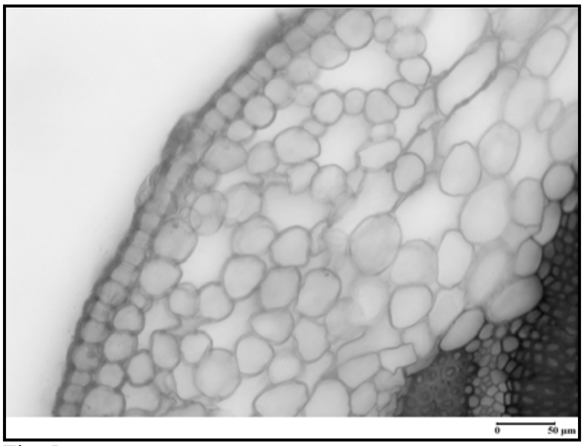

Fig. 5

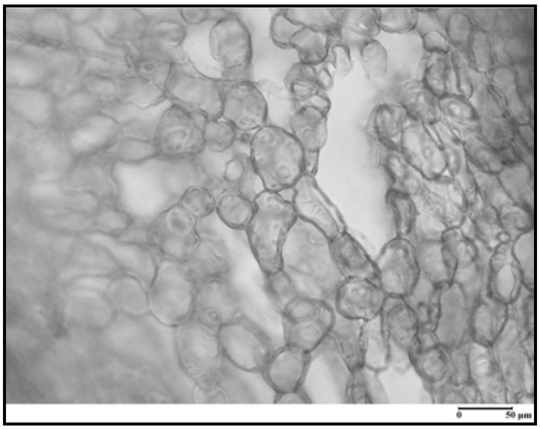

Fig. 4

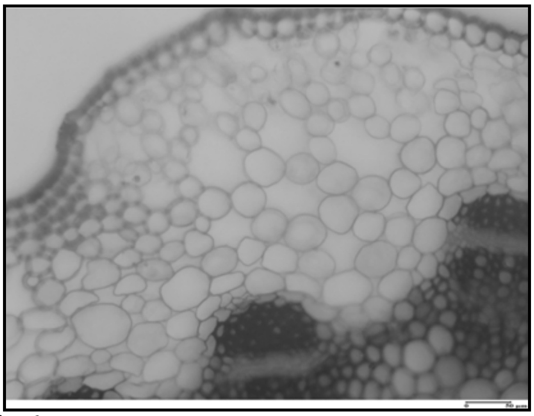
Fig. 6

Cross section : *Artemisia santonica* - root (Fig.1, 2 and 3); *Aster tripolum* ssp.*pannonicus* - rhizome (Fig. 4) and stem (Fig. 5 and 6)

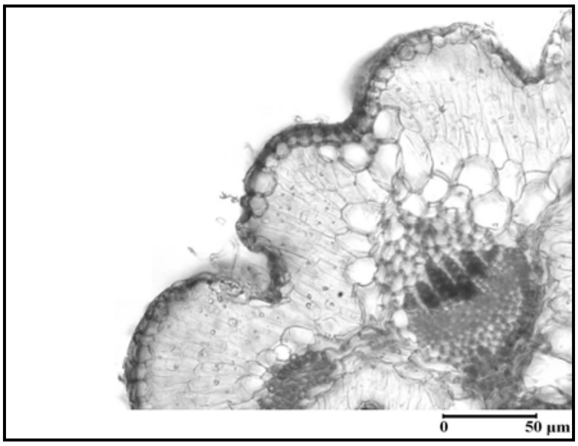

Fig. 7

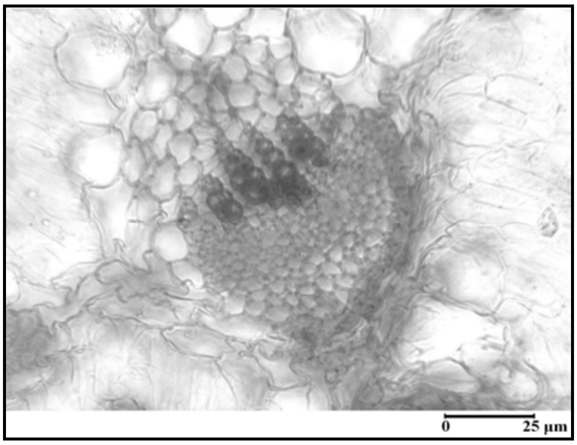

Fig. 8

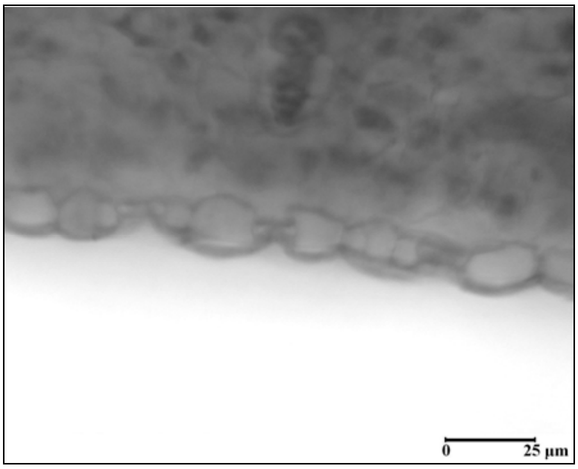

Fig. 9

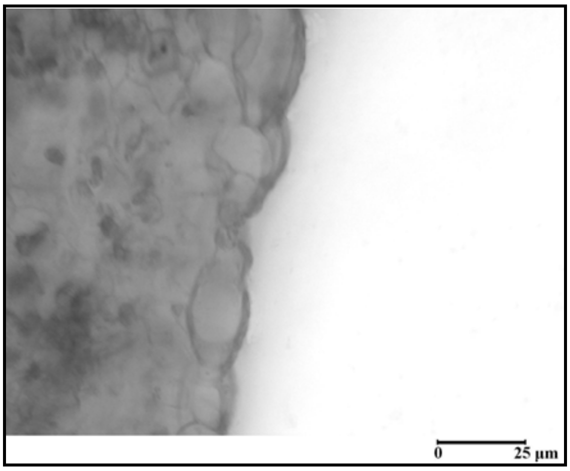

Fig. 10

Cross section: *Artemisia santonica* - lamina (Fig. 7 and 8); *Lactuca saligna* - lamina (Fig. 9 and 10)

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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MORPHOBIOMETRICAL DATA REGARDING THE INFLORESCENCE OF *AGROPYRON CRISTATUM* (L.) Gaertner CULTIVATED IN DIFFERENT ECOLOGIC CONDITIONS

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ABSTRACT

TOMA C., ZAMFIRACHE M. M., 2006 – Morphological data regarding the inflorescence of *Agropyron cristatum* (L.) Gaertner cultivated in different ecologic conditions. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 99-102.

In this paper we present some morph-biometrical data regarding the variability of the *Agropyron cristatum* (L.) Gaertner inflorescence (spike). The material was collected from numerous sites and locations and then grown in standard conditions in The Negresti Soil Research Centre (Vaslui district). From our research we have concluded that the plant's habits remain the same even 10 years after the transplantation to the experimental soil at Negresti. These values are really useful for agriculturists in their activities to improve the grasslands.

Key words: *Agropyron cristatum* , morpho-biometrical measurements, ecological conditions

Introduction

Agropyron cristatum (L.) Gaertner is a dens cespiteux species, with a short rhisome and sterile offspring (Anghel and Morariu, 1972). The plant reaches 20-60 cm, the stem is erect and/or upward, hairy in the third lower part. The spike is 2-6 (8) cm long and up to 2,5 cm wide, with 40-50 (60) smaller spike, each 8-15 mm long and each with 3-6 (10) flowers (Anghel and Morariu, 1972).

Agropyron cristatum is a fodder plant, very precious for the dry areas. It is cultivated in a mixture with other fodder plants, for improved artificial cultures in the dry areas of the country.

In Romanian Flora vol. II (Anghel and Morariu, 1972), it is mentioned that the *A. cristatum* it is called *Agropyron pectiniforme* Roem. et Schult., var. *pectiniforme* (with yellow small spike), being synonym to *Agropyron pectinatum* P. Beauv., or with *Triticum pectinatum* M.B.

In the Ilustrated Flora of Romania (Ciocârlan, 2000), the plant is not included under the name of *A. pectiniforme*, but under the *A. cristatum* (L.) Gaertner name, with 4 subspecies: *cristatum*, *sabulosum*, Lavr., *prodanii* Ciocârlan and *pectinatum* (Bieb.) Tzvelev.; the last subspecie is synonime to var. *pectiniforme* (mentioned in Romanian Flora, vol. XII) and with *Agropyron pectinatum* P. Beauv., being characterized (Ciocârlan, 2000) by an ear with spaces between the small spike, a hairy stem under the spike and thin in the lower part, a foliar limb with long non - glandular hairs on its both sides. The *pectinatum* subspecies is rare in the step areas, sunny and dry regions in the *Quercus petraea* level.

Our previous investigations, (Toma et al., 1973) have shown the fact that *A. cristatum* subsp. *pectinatum* stem is 60 cm tall (and even 80 cm), and the foliar limb is 20 cm long and 8 mm wide. These measurements varied from year to year, different species and from origin to origin. This needs to be taken into account when specie, subspecies or a variety is being studied; a taxon's characterization needs to be made along the research of a wide material, coming from very different ecological conditions.

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Material and method

In this contribution we will only refer to the morphological variability of spike, relying on observations, measurements and counting, conducted on a wide material collected from different places and then cultivated in standard conditions at the Negresti Soil Research Center (Vaslui district).

The analyzed material comes from 27 locations (graphics 1-3) belonging to Galați and Vaslui Districts; in parallel we have studied in the Agricultural Researches Institute (I.C.A.) the material available (in 1973) in the Negreşti center collections[**)].

The differences related to the origins of the materials are so obvious the one might think that we are dealing with different species or at least subspecies. In reality all the material belongs to one specie and that is *Agropyron cristatum* Gaertner ssp. *pectinatum* (Bieb.) Tzvelev.

The observations that were made along 10 years (1963-1972), show that the morphological features of the transplanted material in the mentioned researches center[***)] remained unchanged when compared to the initial biotopes.

This researches, which is continuing the study in 1973 (Toma et al., 1973), only involves the inflorescence: length and width of the spike, the number of smaller spike, the measurements and counting being made along 3 consecutive years (1970, 1971, 1972), in the first decade of June on 25 individuals for each of the 33 origins. The collected data is included in table I and 1-3 graphics; we mention that in these graphics there are only 18 origins because for locations with more than one stations (A, B, C), vas calculated an average value, considering the more or less similar conditions in which the material was growing, before being transplanted in the Negreşti Soil Research Center.

In this contribution we also rely on the prior investigations (Toma et al., 1990) on the *A. elongatum*, *A. bessarabicum* and *A. junceum*, were we have also studied the spike components.

Results and disscutions

The general aspect, the spike's dimensions and the number of small spikes (graphic 1-3) show large variations for different origins, mentioned in the consulted literature: Anghel and Morariu (1972); Ciocârlan (2000). The length of the spike: (graphic 1) is sensibly different (from 24 mm – Aldeşti/1971, to 100 mm – Valea Mărului/1971), the most origins having the spike longer than 50 mm. as well as in the case of the stem, the leaf (Toma et al., 1973 a), smaller values are recorded in 1970, which demonstrates once more that in high humidity conditions not only the vegetative sphere but also the reproductive one is small in quantity, and this has a negative effect on the value of fodder plants.

The width of the spike (measured at the base) (graphic 2) shows the same variations from origin to origin and from year to year. The longest ears have the smaller width.

The number of small spike (graphic 3) in a flower is between 8 (Aldeşti/19719) and 54 (Valea Mărului/1972). The majority of the studied origins have smaller values than the ones in the consulted literature (Anghel and Morariu, 1972), under 40 small ears. The counting made in 1970 show the smallest values in according to the mentions over the prior analyzed parameters (Toma et al., 1973 a) for stem and leaf.

As well as for the overall image of the spike (considering the analyzed parameters), it can be observed on plates I-VI; were one can see again how variable the number of small spikes is. Except the mention made by Ciocârlan (2000), about the density of small spikes, our observations do not confirm, in most cases, the fact that there are spaces between small spikes at *pectinatum* ssp.

Conclussions

Our investigations rely on almost 7000 measurements and counting, and then average values were calculated and added to table I and in 1-3 graphics.

The general aspect of the plant and especially the spike shows that within the *Agopyron cristatum* ssp. *pectinatum* there are numerous ecologic forms, most of them belonging to the *pectiniforme* variety (Anghel and Morariu, 1972) or *pectinatum* ssp. (Ciocârlan, 2000). The plants habits remained the same 10 years after they were transplanted to the Negresti Soil Research Center (which today doesn't exist any more).

By our measurements and counting is verifying the fact that the *Agropyron cristatum* is very resistant to drought, and does not support excessive humidity and flooding. The biggest values were obtained in 1971 and 1972 (in 1970 being excessive humidity). These values are of a high importance in plant improving in our country.

References

1. ANGHEL GH., MORARIU I., 1972- *Agropyron* Gaertn. In: Flora R.S.R., Ed. Acad. Rom., Bucuresti, 12: 600-623.
2. CIOCÂRLAN V., 2000 – *Agropyron* Gaertn. In: Flora ilustrată a României. Pteridophyta şi Spermatophyta. Ed. Ceres, Bucureşti: 1035-1036.

[***] To our regret the plant collections in Negresti Soil Research Center (Vaslui district) could not brought to the Botanical Garden in Iasi in 1977 as we intended.

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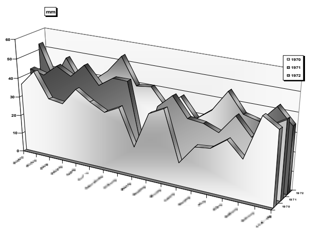
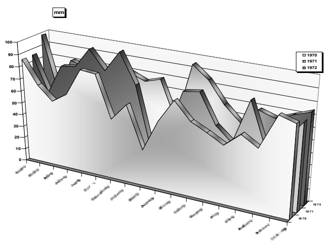
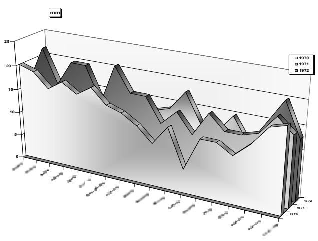
3. TOMA C., MOVILEANU V., CÎRLAN V., RUGINĂ R., FLENCHEA G., TONIUC A., 1973 a – *Observații morfo-ecologice asupra speciei Agropyron pectiniforme* Raem. et Sch. St. Com. Muz. Şt. Nat. Bacău, 6: 7-28.
4. TOMA C., FLENCHEA G., TONIUC A., RUGINĂ R., MOVILEANU V., 1973 b – *Observații anatomo-ecologice asupra speciei Agropyron pectiniforme* Raem. Et Sch. St. Com. Muz. Şt. Nat. Bacău, 6: 29-48.
5. TOMA C., TONIUC A., FLENCHEA G., MOVILEANU V., 1973 c – *Observații anatomo- ecologice asupra speciei Agropyron pectiniforme* Raem. Et Sch. II Tulpina. St. Com. Muz. Şt. Nat. Bacău, 6: 49-68.
6. TOMA C., CONSTANTINIU S., NITA M., 1990 – *Cercetări de morfologie şi anatomie comparată asupra unor specii de Agropyron* Gaertn. An, Şt. Univ. „Al. I. Cuza" Iaşi, s II a (biol.), 36: 5-14.



Graphic no 1 – Tle length of inflorescence (spike) from *Agropyron cristatum*



Graphic no 2 - The breadth of inflorescence (spike) from *Agropyron cristatum*



Graphic no 3 – The number of inflorescences (spikes) from *Agropyron cristatum*

Plate I – *Agropyron pectiniforme* -*Virlez,* Galati district

Plate II - *Agropyron pectiniforme* – Adam, Galati district

Plate III- *Agropyron pectiniforme* - Aldesti, Galati district

Plate V - *Agropyron pectiniforme* – Rebiceati, Vaslui district

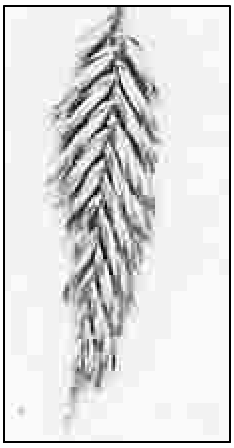


Plate IV - *Agropyron pectiniforme* – Buhaiesti, Vaslui district

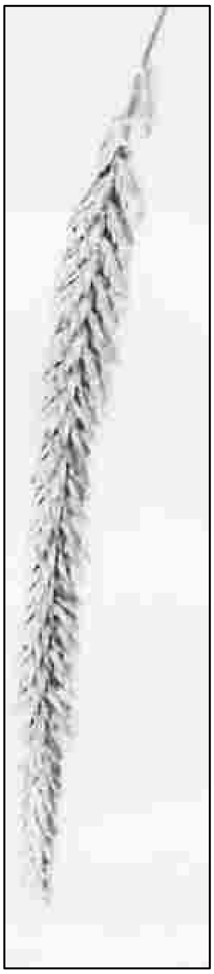


Plate VI - *Agropyron pectiniforme* – I.C.A - 110

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 103 – 105

CONTRIBUTION TO THE STUDY OF VASCULAR FLORA FROM THE VANATORI NEAMT NATURAL PARK

MIHAELA DARABAN*

ABSTRACT

DARABAN M., 2006 – Contributions to the study of vascular flora from the Vanatori Neamt Natural Park. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol.21: 103-105.

This article intendes to present to you the vascular flora from Natural Park Vanatori-Neamt.

Key words: floristical researches, vascular flora.

Introduction

Vanatori Neamt Natural Park is situated in the north of Neamt county, at the border with Suceava, within the communes Cracaoani, Agapia, Vânatori Neamt, of the town Tg. Neamt, and the Baltatesti and Oglinzi resorts.

The surface of the park is of 30.818 ha, from which 26.322 ha forest.

Material and method

The establishment of the floristical conspect was made on the basis of consulting 52 floristical researches (921 taxons) and completed with personal researches. (61 taxons) [2, 3, 5, 6, 7, 8, 12, 13]

Results and discussions

The results of the investigation developed between the years 2004-2006, as well as the existing literature data in the field, on the floristic diversity of the Park Vânători – Neamţ, put into evidence the presence of 982 chormophyte species, belonging to 98 families and 393 genera (Tab.1).

Conclusion

Until now, from the studies performed in time, a number of about 982 taxons have been identified, what represents about 33% of Neamt county flora.

Rezumat

Până în prezent, din studiile efectuate in timp, au fost identificati un numar de 982 taxoni care reprezintă aproximativ 33% din flora judetului Neamt.

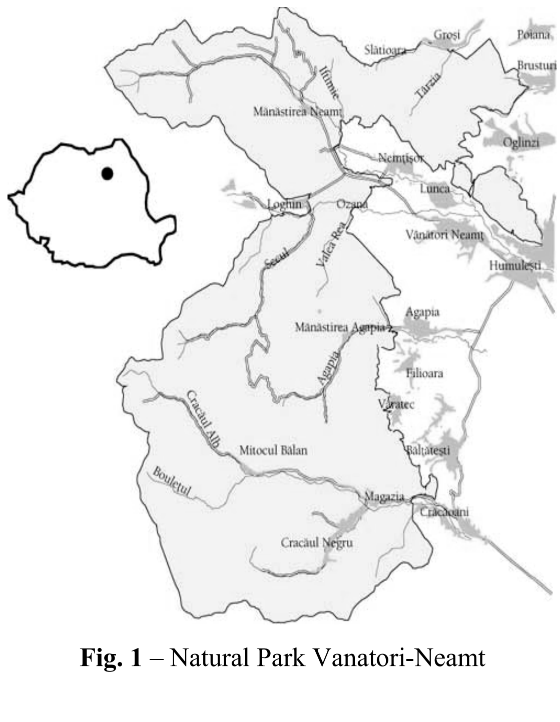


Fig. 1 – Natural Park Vanatori-Neamt

* "Al. I.Cuza" University of Iasi, Faculty of Biology

Tab. 1 – Vascular flora of Park Vanatori-Neamt

	Pteridophyta	
	Family	***Genera***
1	Aspleniaceae	9
2	Dennstaedtiaceae	1
3	Equisetaceae	1
4	Lycopodiaceae	1
5	Selaginellaceae	1
6	Ophyoglossaceae	1
7	Polypodiaceae	1
TOTAL	**8**	**15**
	Spermatophyta Pinophytina	
	Family	***Genera***
1	Cupresaceae	1
2	Pinaceae	4
3	Taxaceae	1
TOTAL	**3**	**6**
	Spermatophyta Magnoliophytina	
	Magnoliopsida (Dicotiledonatae)	
	Family	***Genera***
1	Aceraceae	1
2	Amaranthaceae	1
3	Apiaceae	26
4	Apocynaceae	1
5	Araliaceae	1
6	Aristolochiaceae	2
7	Asclepiadaceae	1
8	Asteraceae	48
9	Balsaminaceae	1
10	Berberidaceae	1
11	Betulaceae	2
12	Boraginaceae	10
13	Brassicaceae	19
14	Campanulaceae	3
15	Cannabaceae	1
16	Caprifoliaceae	3
17	Caryophyllaceae	14
18	Celastraceae	1
19	Ceratophyllaceae	1
20	Chenopodiaceae	1
21	Cistaceae	1
22	Coryllaceae	2
23	Cornaceae	1
24	Convolvulaceae	2
25	Cuscutaceae	1
26	Dipsacaceae	4
27	Ericaceae	1
28	Euphorbiaceae	2
29	Fabaceae	19
30	Fagaceae	2
31	Fumaricaceae	1
32	Gentianaceae	3

33	Geraniaceae	2
34	Grossulariaceae	2
35	Haloragaceae	1
36	Hypericaceae	1
37	Lamiaceae	22
38	Linaceae	1
39	Loranthaceae	1
40	Lythraceae	2
41	Malvaceae	3
42	Monotropaceae	1
43	Oleaceae	2
44	Onagraceae	3
64	Solanaceae	5
65	Saxifragaceae	2
66	Tamaricaceae	1
67	Thymaelaeaceae	2
68	Tiliaceae	1
69	Ulmaceae	1
70	Urticaceae	1
45	Orobanchaceae	1
46	Oxalidaceae	1
47	Papaveraceae	2
48	Phytolacaceae	1
49	Plantaginaceae	1
50	Polemoniaceae	1
51	Polygalaceae	1
52	Polygonaceae	2
53	Portulacaceae	1
71	Valerianaceae	1
72	Verbenaceae	1
73	Violaceae	1
TOTAL	**73**	**301**
	Liliopsida (Monocotiledonatae)	
	Family	*Genera*
1	Alliaceae	1
2	Alismaceae	1
3	Araceae	1
4	Cyperaceae	5
5	Iridaceae	1
6	Juncaceae	2
7	Lemnaceae	1
8	Liliaceae	11
9	Orchidaceae	12
10	Poaceae	31
11	Potamogetonaceae	1
12	Sparganiaceae	1
13	Trilliaceae	1
14	Typhaceae	1
TOTAL	**14**	**70**

References

1. ELDIE AL., 1977, 1979 - *The illustrated flora of Romania* , I, II, Edit. Acad. Rom., Bucharest
2. BRÂNDZĂ D., 1879-1883 – *The prodrom of flora from Romania*, Acad. Română, Bucharest.
3. BURDUJA C., CHIFU T., 1974 - *Flora and vegetal association of Dumbrava Forest from Vanatori-Neamt*, St. cerc. şt., Geol.-Geogr.-Biol., Bot.-Zool., Muz. Şt. Nat., Piatra Neamţ, II : 161 – 172.
4. CHIFU T., DĂSCĂLESCU D., ŞTEFAN N., FLOREA DANIELA, 1972 – *Contribution to the study of flora from the Moldova*, St. com., Muz. Şt. Nat. Dorohoi, Botoşani : 79 - 82
5. CHIFU T., MITITELU D., DĂSCĂLESCU D., 1987 - *Flora and vegetal association from Neamt county*, Mem. secț. şt., Acad. Rom., X, 1 : 281 – 302.
6. CHIFU T., ŞTEFAN N., ONOFREI TR., 1974 – *The vascular flora from the Nemtisor River's bassin*, St. cerc.,Geol.-Geogr.-Biol., Bot.-Zool., Muz. Şt. Nat., Piatra Neamt, II : 85 – 107.
7. CHIFU T., ŞTEFAN N., SLONOVSCHI V., ONOFREI TR., 1971 – *Floristical notes*, Com. Bot., S.S.N.G., Bucharest, XII : 181-183.
8. CIOCÂRLAN V., 2000 - *The illustrated flora of Romania, Pteridophyta et Spermatophyta*, Edit. Ceres, Bucharest.
9. CRISTEA V., GAFTA D., PEDROTTI FR., 2004 - *Fitosociologie*, Edit. University Press of Cluj, Cluj-Napoca
10. ELLENBERG H., 1974 - *Indicator values of vascular plants in Central Europe*, 9, Göttingen : 7 – 97.
11. GRECESCU D., 1898 – The *conspect of Romania's flora*, Edit. Dreptatea, Bucharest
12. MITITELU D., 1993 - Vegetal *association from forests reservations*, St. cerc., Muz. Şt. Nat., Piatra Neamt, VII : 3 – 8.
13. MITITELU D.,1992 - *Flora and vegetal association from near Neamt county*, St. cerc., Muz. Şt. Nat., Piatra Neamt, VI : 65 – 81.
14. St. cerc., Muz. Şt. Nat., Piatra Neamt, VI : 65 – 81.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 106 – 109

FLORISTIC NOTES FROM CARAS SEVERIN DISTRICT, RESIȚA AND SURROUNDINGS. PART II

ILIE D. GOGA*

ABSTRACT

GOGA I. D., 2006 - Floristic notes from Caras Severin district, Resita and surroundings. Part II. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 106-109.

The author presents the results of the botanical research effectuate in the Caras-Seven counties, Resita and surroundings. Among the rare taxa from this district, is presented *Bidens frondosa* L., in fourth station and *Saxifraga trydactylites* L. f. *exilis* (Pall.) Engler found in the station of district.

Keywords: floristic notes, rare taxa, Caras Severin district, Resita.

We present other floristic data gathered during past years from different locations. The first note is under print.

Fam. Ranunculaceae

Aconitum moldavicum Hacq. Resita, Cuptoare at Capu Baciului and Valea Domanului through the forest on rocky slopes with many calcar.

Fam. Papaveraceae

Papaver rhoeas L. Resita in Valea Domanului through the forest on rocky slopes.

P. dubium L. f. *filicaule* A. Nyár. Resita-Calnic near to the railway to Com. Ezeris.

Obss. This form is quoted only from B. Herculane, Cazane, Plavisevita and from Oltenia at sandy dunes Obedeanu-Craiova.

Corydalis solida (L.) Sw. Anina through the forest, frequent.

Fam. Saxifragaceae

Saxifraga tridactylites L. along with f. *exilis* (Pall.) Engler (Fig.1), Resita on Dealul Gol in pasture, on calcareous rocks.

Obs. This form is quoted from Banat, from Ostrovul de la Moldova Noua. This form is different through her delicate aspect. The stem is very thin with one or a few flowers (characteristic form for poor places).

Fam. Rosaceae

Potentilla erecta L. Hampe var. *strictissima* (Focke.) Resita-Cuptoare in Poiana Ponor through mountain meadows.

P. inclinata Vill. Globu Craiovei in Chei beside the road.

P. argentea L. var. *disecta* (Wallr.). Resita – Calnic on Dealul Talva Mare, f. *latisecta* (Sam.) in pasture.

P. ternate C. Koch. Semenic Mountain in the glade through arid places.

P. erecta L. Globu Craiovei, in Chei on rocky slopes, Resita on Dealul Gol in pasture.

P.crysantha Treb. ssp. *chrysantha*, Globu Craiovei, in Chei on rocks and shrubs.

Fam. Fabaceae (Leguminoase)

Sarothamnus scoparus (L.) Wimmer. Resita to Dealul Radoi in dry pasture.

Cytisus nigricans L. Resita on Valea Raului Mare in the forest; Valea Raului Starnic beside the road on rocky slopes, Calnic near to the railway.

C. austriacus L. Resita in the forest Ranchina through glades.

Chamaecytisus hirsutus (L.) Link. ssp. *leucotrichus* (Schur.) L. Löve. Resita in the forest to Sura. Valea Starnic through shrubs; B. Herculane in the forest on calcareous rocks to Ciorici peak; Resita on Valea Raului Mare and on Valea Domanului in the forest beside the road.

Charagana arborescens L. Resita in Lunca Barzavei in the park and at Marginea on the road.

Astragalus cicer L. Resita in the city at locomotives shed on the shunting yard.

* RO-320127-Reşiţa, Bd. Republicii, Bl. 7, sc. II, et. VII, ap.29, Jud. Caraş Severin.

Vicia sepium L. Com. Valiug at Klaus villa in pasture; Calnic in the village beside the fences; on Dealul Lupacului in pasture.

V. pisiformis L. Resita in the forest Ranchina on rocky slopes and on Dealul Ciorii in the forest.

V. villosa Roth. Com. Mehadia on the field in dry pastures.

V. cassubica L. Resita on Dealul Perovei in pastures; Valea Starnic through the forest, in pastures; Dealul Lupacului in pastures; Brazava river Valley in the city.

V. cracca L. var. *liniaris* Peterm. Resita on the bank of Barzava river in the city.

Lathyrus venetus (Mill.) Wohlf. B. Herculane at Crucea Alba in the forest.

L. vernus (L.) Bernh. Resita on Dealul Terovei in the pasture; Valea Starnic in the forest; Cuptoare in Valea Sodol in the forest, Ranchina in the pasture, on Dealul Ciorii in the pasture; Valea Doman in the forest; Moldova Noua, Oravita on Valea Marila in the forest.

Fam.Euphorbiaceae

Chamaesys maculate (L.) Small. (*Euphorbia maculate* L.) Moldova Noua through dry meadows and on rocky places; Otelul Roşu PECO gas station; Oravita in the railway-station beside railroad.

Euphorbia epithymoides L. Globu Craoivei on rocky slopes.

E. exigua L. Com. Berzovia on Dealul Pohancea in stubble fields.

E. cyparissias L. Globu Craiovei in the Chei on rocky slopes.

Fam. Araceae

Acer pseudoplatanus L. Resita on Valea Starnic beside the creek, f. *purpurascens* Pax. in "Doi arbori" Zoo Park.

Fam. Hypericaceae

Hypericum maculatum Cr. var. *typicum* (Frölich). Anina in the forest, through glades; Resita on Dealul Terovei in pastures.

Fam. Brassicaceae (Cruciferae)

Allyssum murale Waldss. et Kit. Resita beside railway to Com. Ezeris, rare; var. *microcarpum* Nyár. Cheile Globului Craiovei rocky slopes; var. *variabilite* f. *ellipticum* Nyár. Globul Craiovei in Chei on rocky slopes.

Fam. Cucurbitaceae

Bryonia alba L. Resita on Valea Raului Mare beside forestal road in the wood.

Fam. Apocynaceae

Vinca minor L. Resita on Valea Starnicului in the forest and on Valea Domanului on pastures and gravels; Caransebes in the forest to Teius CFR way station.

Fam. Boraginaceae

Heliotropium europeum L. Moldova Noua in Orasul Nou **in locuri virane.**

Fam. Lamiaceae (Labiatae)

Prunella laciniata (L.) L. Resita pe Dealul Gol prin tuferisuri.

Stachys erecta L. var. *grabrata* Simk. B. Herculane on calcareous debris.

Acinos alpinus (L.) Moench. (*Calamintha alpine* (L.) Lam.) ssp. *majoranifolius* Miller P.W.Ball. B. Herculane (Pecinisca) in Cheile Prolaz on rocky slopes.

Thymus alpestris Tausch ex. A. Kerner. Resita, Valea Barzavitei on rocky places.

T. pannonicus All. Caransebes at Teius CFR way station in pastures; Com. Mehadia in pastures near to the Belareca river; Brebu Nou through mountain pastures.

Mentha incana Willd. Resita in Valea Starnic through pastures.

M. verticillata L. Resita-Cuptoare in Valea Baciului through pastures.

M. longifolia (L.) Nath. Com. Valiug. in the forest at Crivaia through mountain pastures.

Fam. Callitrichaceae

Callitriche palustris L. (*C. verna* L.) Resita to Clocotici village near the creek, in pastures.

Fam. Scrophulariaceae

Linaria genistifolia (L.) Miller. and *L. vulgaris* Miller. Globul Craiovei in Chei on rocky slopes.

Rhinanthus minor L. Resita on Dealul Bucitu in pastures.

Fam Rubiaceae

Galium flavescens Borbás. Globu Craiovei in Chei on rocks beside road.

Fam. Asteraceae (Compositae)

Bidens frondosa L. (Fig.2). Globu Craiovei in Chei through dikes near the road.

Obs. So far it was mentioned from Banat at B. Herculane, Bozovici and Garbovat. Taxon is currently spreading.

Anthemis ruthenica M.B. var. *monocephala* Grec. Resita on Dealul Gol in the forest.

Matricaria discoidea DC. Caransebes in the glade to Teius way station.

Senecio subalpinus Koch. Com. Valiug, Poiana Crivaia in humid pastures.

Carduus nutans L. Bocsa in pastures; Resita on Dealul Gol on calcareous rocks and on bank of Barzava river.

C. crispus L. Resita on Valea Raului Mare in the forest.

C. candicans Waldst. et Kir. Baile Herculane in Cheile Prolaz on calcareous debris; Globu Craiovei beside the road.

Cirsium decussatum Janka. Resita on Valea Doman in the forest on rocky slopes.

Jurinea mollis (L.) Reichenb. Baile Herculane on Vf. Suscu on calcareous rocks.

Centaurea jacea L. Resita la Minda beside road and at Cuptoare in mountain pastures.

C. atropurpurea Waldst. et. Kit. B. Herculane in Cheile Prolaz on rocky slopes.

C. scabiosa L. Globu Craiovei in Chei on rocky slopes; ssp. *spinulosa* (Roch.) Resita-Cuptoare in Poiana Ponor through pastures.

C. stoebe L. (*C. rhenana* Boreau) Resita on Dealul Gol in pasture; Oravita on Valea Marila on rocks in forest; Resita on Dealul Lupac in dry pastures.

Hypochaeris maculate L. Resita-Calnic in pastures on Dealul Stan.

Leontodon crispus Vill. ssp. *crispus*. B. Herculane in Cheile Prolaz through pastures.

Lactuca quercina L. ssp. *sagitata* (W. et K.) Celak. Oravita in Valea Marila through forest.

Lactuca saligna L. Globu Craiovei in Chei through rocky places.

Hieracium lactucella Wallr. (*H. auricular* Lam.) Semenic Mountain in meadow.

H. piloselloides Vill. ssp. *obscurum* (Rchb.) Nyar. Baile Herculane at Sapte Izvoare on rocky slopes.

Fam. Dioscoriaceae

Tamus communis L. Resita on Valea Starnicului in the forest, Dealul lui Stan through shrubs, var. *cretica* (L.) Boiss. Dealul Lupacului in Valea Raului Mare through shrubs.

Fam. Liliaceae

Gagea lutea (L.) Ker-Gawl. Resita-Cuptoare on Baciului creek in the forest; in Valea Starnic in the forest, leaf: 2,05 mm; f. *simplex* (Schur).

G. pratensis (Pers.) Dumort. Anina on hills through shrubs; Resita in Valea Starnic through the forest.

Scilla bifolia L. var. *bifolia* f. oec. *uniflora* G. Grint in Valea Starnic through the forest.

Muscari tenuifolium Tausch. Baile Herculane through pastures near the lime factory.

Ornithogalum gussonei Ten. Resita on Dealul Gol in pasture and through shrubs of *Crataegus monogyna* Jacq.

Allium flavum L. Com. Carasova on calcareous rocks near the village; Globu Craiovei in Chei on rocky slopes.

A. paniculatum L. ssp. *fuscum* (W. et K.) Jáv. Oravita in Valea Marila on rocks in the forest ; B. Herculane through the forest.

Fam. Iridaceae

Iris reichenbachii Heuffel. Globu Craiovei in Chei on sunny rocks.

Fam. Orchidaceae

Orchis mascula (L.) ssp. *signifera* (Vest) Soó. Baile Herculane, Pecinisca village through pastures.

O. coriophora L. Resita on Dealul Arsilor in pastures.

Dactylorhiza maculate (L.) Soó. (Fig. 3). Anina la Iudina in the fir forest on humic calcareous soil.

Gymnadenia conopsea (L.) R. Br. Resita on Dealul Bucitu in pastures with *Platanthera bifolia* Rich.

Spiranthea spiralis (L.) Chevall. Com. Dognecea at stone pit through pastures and at Resita on Dealul Ciorii through pastures.

Fam. Poaceae (Gramineae)

Festuca altissima All. Resita on the bank of Barzava river near to Resita-Nord railway station.

F. airoides Lam. Semenic Mountain on Vf. Gosnei on rocks.

Vulpia bromoides (L.) S.F. Gray. Resita at Minda beside road through schrubs.

Koelearia nitidula Vele. Globu Craiovei in Chei beside the road and on the rocks.

Obs. Quoted from Dobrogea de Sud, new for Banat.

Fam. Lemnaceae

Lemna minor L. Resita near to Barzava river in sloughs.

Rezumat

Autorul prezintă rezultatele cercetărilor botanice efectuate în județul Caraş-Severin, municipiul Reşița şi împrejurimile sale.

Printre „taxonii" rari din acest județ, autorul citează *Bidens frondosa* L şi *Saxifraga trydactylites* L. f. *exilis* (Pall.) Engler.

References

1. BELDIE AL., 1977-1978 – *Flora Romaniei* I - II, Bucuresti.
2. CIOCARLAN V., 2000 – *Flora Ilustrata a Romaniei*. Editura Ceres, Bucuresti.
3. CARTU M., CARTU M., 1972 - *Studii si Comunicari*. Muz. St. Nat. Bacau, p. 114.
4. HEGI G., 1906-1931 – *Flora Mitteleuropa*, Band IV/2, p. 132.

Fig.1- *Saxifraga tridactylites* L. f. *exilis* (Pall.) Engler

Fig. 2 - *Bidens frondosa* L.

Fig. 3 - *Dactylorhiza maculate* (L.) Soó.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 110 – 119

THE CHOROLOGY OF SOME ALPINE SPECIES OF RANUNCULACEAE FAMILY IN ROMANIAN CARPATHIANS

VASILE SANDA[*], SORIN ŞTEFĂNUȚ[*], NECULAI BARABAŞ[**]

ABSTRACT

SANDA V., ŞTEFĂNUȚ S., NECULAI BARABAŞ, 2006 – The chorology of some alpine species of Ranunculaceae family in Romanian Carpathians. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 110-119.

Chorological, ecological and coenotical data of some rare species of *Ranunculaceae* family are presented in this paper, especially alpine and subalpine species, as: *Anemone baldensis* L., *Aquilegia transsilvanica* Schur, *Callianthemum coriandrifolium* Reichenb., *Delphinium simonkaianum* Pawl., *Ranunculus glacialis* L., *R. thora* L. and *Thalictrum alpinum* L.

Key words: Ranunculaceae, alpine species, chorology, Romania.

Introduction

In the frame of mapping Carpathians Flora, started in 1965-1975 by Institute of Biology, Romanian Academy, was published many chorological maps for rare, endemic and threatened species. Also, four volume of *Atlas Florae Romaniae* (*Pinophytina, Betulaceae, Quercus, Salix*) was published, which turn account whole heritage of literature and Research Centres, Universities and County or City Museums Herbaria data.

The Ranunculaceae species: *Anemone baldensis* L., *Aquilegia transsilvanica* Schur, *Callianthemum coriandrifolium* Reichenb., *Delphinium simonkaianum* Pawl., *Ranunculus glacialis* L., *R. thora* L. and *Thalictrum alpinum* L., mapped by as in this paper, are rare elements of Romanian Flora, spreads especially in subalpine and alpine zones on abrupt mountain paths slopes, on rocks, except *Delphinium simonkaianum* which growth in hills region only.

Usual abbreviations for herbariums consulted:

BCHM – Herbarium of Bacău County Museum; BVHU – Herbarium of "Transilvania" University, Braşov; BUCA – Herbarium of Bucharest Institute of Biology; BUCM – Mycological Herbarium of Bucharest Institute of Biology; BNHM – Herbarium of Bistrița Năsăud County Museum; CL - Herbarium of Cluj-Napoca Botanical Garden; CLA – Herbarium of Agronomical Institute of Cluj; FRE – Flora Romaniae Exsiccata; GLHM - Herbarium of Galați County Museum; IANB – Herbarium of „Nicolae Bălcescu" Agronomical Institute, Bucharest; I – Faculty of Biology Iaşi Herbarium; IAŞI - Herbarium of Agronomical Institute Iaşi; ICAS – Herbarium of Forestry Research Institute; PLHM - Herbarium of Prahova County Museum; PTHM - Herbarium of Argeş County Museum; SIB – Herbarium of Brukenthal Museum from Sibiu; SMHM - Herbarium of Satu Mare County Museum; TMHM – Herbarium of Timiş County Museum; TMJM – Herbarium of Mureş County Museum of Natural Science.

Chorological data

***Anemone baldensis* L.**

This species growth on stony and herbaceous places, in subalpine and alpine zone (Fig. 1). The presence species in Romania is less confirmed in new phytosociological papers.

Rodnei Mountains

LN27 – Pietrosul Rodnei (27); LN36 – Corongiş (9), Gemenea (9), Ştiol (9); LN37 – Galați Peak (9); LN46 – Ineu Peak (9), CL, leg. A. Czetz, 1851, Wolff, year ?;

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Munții Călimani

LN62 – Călimani Mountains (9), Călimani Reserve (9).

Aquilegia transilvanica Schur

The species growth on stony and herbaceous places in subalpine and alpine zone, on schists stones (Fig. 2).

Hăşmaş Mountains

MM06/07 – Hăşmaşul Mare, CLA, leg. B. Kümmerke, 1902.

Bucegi Massif

LL72 – Mălăieşti Valley, TMHM, leg. N. Vlaicu, 1973, 1978; Peştera Hermitage (9); Ialomița's Cave (1), PLHM, leg. A. Vlădescu 1937; Jepi Valley (1), IANB, leg. P. Cretzoiu, 1944; Brâul lui Răducu, IANB, leg. P. Cretzoiu, 1944; LL83 – Caraiman (1,9);

Piatra Craiului Mountains

LL64 –Funduri Saddle (6), Crăpătura Valley (6);

Făgăraş Mountains

Without locality, CL, leg. V. Borbás, 1884, IAŞI, I, leg. M. Toma, 1963; PLHM, leg. G. Negrean, 1963, BNHM, leg. R. Rösler, 1960;

KL95 – Suru Peak (5,9); KL96 – Dracului Peak, above Racovița (5,9); Racovița, SIB, leg. E. Sigerus, year ?; Avrig Lake (5); LL05 – Şerbota Peak (5); Negoiu Peak (5,9), SIB, leg. M. Fuss 1844,1856; Strunga Ciobanului (5); Ciortea Peak (5,9), SIB, leg. M. Fuss, 1857, leg. Reissenburgen, year ?; Ciortea, SIB, leg. K. Ungar, 1906; LL15 – Arpaş Peak (5,9), SIB, leg. G.A. Kaizer 1850; Arpaşul Mare Peak (5); Arpăşel (5); Arpaşului Valley, CL, SIB, leg. I. Pop, 1953; Arpaşul Mare Valley, CL, leg. J. Papai, 1914; Bâlea Glacial Ring (5); Bâlea Lake (5,9), TMJM, leg. O. Rațiu, 1955, CL, leg. J. Csató, 1887, I. Hodişan 1955, O. Rațiu, 1955, CLA, leg. M. Entz, 1888, SIB, J. Barth, 1907; Bâlea Waterfall (5,9); Bâlea Valley (5,9); Bâlea-Arpaş, CLA, leg. Z. Kárpati, 1935; Buteanu Peak (5); Vârtopu Peak, SIB, leg. M. Fuss, year ?; Vânătoarea Peak (5), Tărâța Peak (5), SIB, leg. K. Ungar, 1919; Podragu Peak (5); Podragu Glacial Ring, BUCA, leg. I. Todor, 1948 (9); Podrăgel (5); Podragu Valley (5); Paltinul Peak (5,9); Muchia Puha (5); Laița (5); Fruntea Moaşei (5); Doamnei Valley (5,9), SIB, leg. M. Fuss, 1858, Piscul Bâlii, SIB, leg. K. Ungar, 1906; Capra Budei (9); LL16 – Cârțişoara, CL, leg. M. Fuss, 1858; Ucea Mare (9), CL, leg. J. Papai, 1914, leg. J.C. Baumgarten, 1802, SIB, leg. J.C. Baumgarten, 1822; Piatra Răsunătoare, SIB, leg. M. Fuss, 1858; LN27 – Moldoveanu Peak (9), BUCA, leg. Al. Buia, 1948; LL36 – Moşului Peak (9); Breaza, FRE 1230, leg. E.I. Nyárády, 1930; Colții Brezei (9).

Parâng Mountains

FR83 – Petroşani, CL, leg. Al. Richter, 1909, leg. S. Bogsch, 1914; GR02 – Parâng Mountain, IAŞI, leg. M. Răvăruț, 1951, SIB, leg. Reissenberger, 1859; Slăvei Lake (9), CL, leg. M. Péterfi, 1908, Al. Richter, 1909; Slăveiul Mare (9);

Retezat Mountains

FR42 – Piatra Măceştilor, CLA, leg. E.I. Nyárády, 1930.

Callianthemum coriandrifolium Reichenb.

The plants growths on stony pasture, especially in alpine zone (Fig. 3).

Coenotical integration: *Achilleo schurii-Dryadetum octopetalae* (Beldie 1967) Coldea 1984 (2).

Rodnei Mountains

Without locality, CL, leg. F. Porcius, 1858;

LN27 – Pietrosul Mare (9); LN36 – Corongiş (9), Gemenea (9); LN37 – Borşa, Izvorul Cailor, SMHM, leg. A. Coman, 1950; Borşa, Păltiniş (9), SMHM, leg. A. Coman, 1939; Puzdrele Peak (9), CLA, leg. A. & E.I. Nyárády, 1972; LN46 – Ineu (9);

Piatra Craiului Mountains

LL54 – Piatra Craiului (6,9);

Făgăraş Mountains

Without locality, IAŞI, leg. I. Căpălnăşan, 1974;

LN15 – Paltinul Peak, SIB, leg. I. Pop, 1953; Bâlea Lake, towards Vânătoarea lui Buteanu (5,9); Arpăşel (5); Buza Căldării in Arpaş Mountain (5); Netedu Peak (5); Paltinul Peak (5);

Delphinium simonkaianum Pawl.

The plants growths in stony hills regions down to glade in forests plain zone (Fig. 4).

Rodnei Mountains

LN36 – Corongiş, SIB, leg. J.C. Baumgarten 1826;

Hăşmaş Mountains

MM09/MN00 – Tulgheş, at Pietrele Roşii (9);

Penteleu Mountain

ML61 – Penteleu Mountain and Ivănețu, BUCA, leg. I. Grințescu, 1915;

Ciucaş Mountains

ML11/21 – Măneciu-Ungureni, BUCA, leg. G. Grințescu, 1916; ML13 – Zăgan Mountain on Telejenel, BUCA, leg. G. Grințescu, 1930, 1933;

Piatra Craiului Mountains

LL63 – Dâmbovicioara Valley (9); Dâmbovicioara Gorges, TMHM, leg. M. Vlaicu, 1978;

Mureş County

LM07 – between Băla and Ercea, on Copăcel Hill (9);

Apuseni Mountains

FS17 – Stâna de Vale, PLHM, leg. Al. Borza, 1936; FS70 – Feneşului Valley (9); FS71 – Gilăului Mountains, above Runc Commune (9); FS90/GS00 – Alba Iulia (9); FS92 – Piatra Cetii (9), FRE 1943, leg. E. Ghişa & E.I. Nyárády, 1938, CL, leg. M. Ciurchea, 1960; Gălzii Valley (9); FS94 – Colțeşti, CL, leg. I. Gergely, 1960; Piatra Urdaşului, TMJM, leg. I. Gergely, 1960; Rochiş, CL, leg. I. Gergely, 1960; Trascău Mountains, CL, leg. E.I. Nyárády, 1931; Colții Trăscăului (9); „Orkskö" Mountain (9).

Ranunculus glacialis L.

Ranunculus glacialis is a petrophylous-acidophylous, that fixed siliceous screes and indicated as characteristic species for *Androsacetalia alpinae* Order, *Thlaspietea rotundifolii* Class. This

Order associations has a low coenotical cohesion and a low lying fallow (Fig. 5).

Coenotical integration: *Primulo-Caricetum curvulae* Br.-Bl. 1926, emend. Oberd. 1957 (10), *Oreochloo-Juncetum trifidi* Szafer et al. 1927 (10).

Rodnei Mountains

Without locality (11);

LN17 – Nedeia Peak, BUCA, leg. P. Bănărescu 1940; LN36 – Corongiş (9,11); LN46 – Ineu (9,11), CL, leg. A. Czetz 1858, Fl. Porcius, year ?;

Făgăraş Mountains

Without locality, SIB, leg. ?, 1807, CL, leg. J.C. Baumgarten 1817, 1827;

KL95 – Suru (9,11); LL15 – Arpaş (9,11), Creasta Tărâța (9,11); LL16 – Ucea Mare (9,11); LL36 – Drăguş (11), SIB, leg. J.C. Baumgarten, year ?;

Ranunculus thora L.

Ranunculus thora is a alpine European endemic plant that growth on grassy calcareous slope, rich in humus. This plant is a heliophylous species that bear temporary shadowing and rare temperature extreme (Fig. 6).

Coenotical integration: *Diantho tenuifolii-Festucetum amethystinae* (Domin 1933) Coldea 1984 (2), *Seslerio haynaldianae-Caricetum sempervirentis* Puşcariu et al. 1956 (2), *Thymio pulcherrimi – Pöetum rehmanii* Coldea (1986) 1990 (2), *Acino-Galietum anisophylli* Beldie 1967 (2,3).

Maramureş Mountains

LP01 – Pop Ivan Mountain (11); LP11 - Groapa Jurii (4,11);

Rodnei Mountains

Without locality, CL, leg. J.C. Baumgarten 1827; Fl Porcius, year ?, F. Täuber & G. Groza 1983, IAŞI, leg. M. Răvăruț, 1950;

LN27 – Maior, SIB, leg. E.I. Nyárády, 1918; Pietrosul Mare (4,7,9,11), IANB, IAŞI, PLHM, BCHM, GLHM, PTHM, leg. A. Coman 1939, SIB, leg. I. Pop, 1956; Iezer, SMHM, ICAS, leg. A. Coman 1937; Iezer Glacial Ring - Pietrosul Mare (2); Gropi Glacial Ring (2); Piciorul Moşului (9), FRE 1940, leg. A. Coman 1939; Turnu Roşu, SMHM, leg. A. Coman 1936, BUCM, leg. G. Negrean 1987; LN28 – Borşa (11), ICAS, leg. A. Coman 1935; Borşa, Aria Zimbrului, SMHM, leg. A. Coman, 1948; LN35, Rodna, ICAS, leg. J. Wolff, 1855; Rodna Veche, BVHU – leg. Fl. Porcius 1874; LN36 – Vinului Valley, SIB, leg. E.I. Nyárády, 1918; Saca Mountain (11), CL, leg. Fl. Porcius, 1883; between Saca Mountain and Corongişul Mic, „Poarta", CL, leg. R. Soó, 1941; „La Poartă", CL, leg. J. Wolff, 1855, Al. Borza, 1925, A. Nyárády, 1953; Corongiş (9), CL, Leg. A. Czets, 1853, Al. Borza, 1925, A. & E.I. Nyárády, 1942, BNHM, leg. A.P. Alexi, 1874; Corongişul Mare, CL, leg. A. Nyárády, 1942, SIB 1932; Corongişul Mic (2); Laptelui Peak, CL, leg. I. Prodan 1916, A. Nyárády, 1953, BUCA, BNHM, leg. A.P. Alexi, 1886; Mihăiasa (9), CL, leg. A. Nyárády, 1953; Putredu (9), BUCA, leg. I. Prodan, 1907; LN37 – Cailor Mountain (9,11); Izvorul Cailor (2), SMHM, leg. A. Coman, 1937; Galați (9); Galați Saddle (2); Piatra Rea (2,4,9), CL, leg. A. & E.I. Nyárády, 1942, SMHM, leg. A. Coman, 1951; Puzdrele Peak (9); Repedea, CL, leg. A. & E.I. Nyárády, 1942; LN38 – Fața Meselor (4,9), CL, leg. A. Coman, 1939, SMHM, leg. A. Coman, 1938; LN46 – Ineu (2); Creasta Tomnatecului, ICAS, PLHM, leg. I. Morariu, 1946;

Bucegi Massif

LL73 – Obârşia Ialomiței (1,9); LL83 – Caraiman (1,9);

Bârsei Mountains

Without locality, CL, leg. J.C. Baumgarten 1826;

LL94 – Piatra Mare (9,11); ICAS, leg. J. Römer, 1887 (sub *R. carparicus*), SIB, leg. J. Römer, 1896, BVHU, leg. J. Römer, 1908;

Piatra Craiului Mountains

LL64 – Piatra Craiului (6,9,11), SIB, leg. J. Römer, 1887;

Făgăraş Mountains

LL05 – Negoiu (5,9,11), SIB, leg. M. Doltu, 1957;

Iezer Păpuşa Mountains

LL43 – Iezer-Păpuşa (6);

Cibin Mountains

KL76/86 – Sadu (11), Sadului Valley (5), Vaca Valley – Sadu (5); KL86 – Prejbe (5,9);

Țarcu-Godeanu Mountains

FR31 – Godeanu (9,11).

Thalictrum alpinum L.

Thalictrum alpinum is a rare alpine plant that growth on abrupt mountain path slope dominated by *Sesleria haynaldiana* and *Carex sempervirens* (Fig. 7).

Coenotical integration: *Seslerio haynaldianae - Caricetum smpervirentis* Puşcariu et al. 1956 (1,10), *Salicetum herbaceae* Br.-Bl. 1913 (10), *Salicetum retuso-reticulatae* Br.-Bl. 1926 (10), *Oxytropido carpaticae-Elynetum* (Puşcariu et al. 1956) Coldea 1991 (10), *Potentilo chrysocraspedae-Festucetum airoides* Boşcaiu 1971 (10), *Oreochloo-Juncetum trifidi* Szafer et al.1927 (1).

Rodnei Mountains

LN46 – Ineu (9);

Ceahlău Mountains

MN20 – Ceahlău (9);

Bucegi Massif

Without locality, I, leg. I. Sârbu, 1976, IAŞI, leg. D. Mititelu, 1956, TMHM, leg. N. Vlaicu, 1974;

LL72 – Colții Obârşiei (1,10); LL82/83 – Cerbului Valley (10); LL83 – the Saddle between Caraiman and Coştila (10); Caraiman (1,9,10), ICAS, leg. Al. Beldie, 1946; Coasta Caraimanului (10), BUCA, leg. I. Şerbănescu, 1948, Gh. Grințescu, 1927; Coştila (1,9,10), ICAS, leg. Al. Beldie, 1946; Piatra Arsă (1,9); Brâna Mare (9); Brâna de Mijloc (1).

Rezumat

Lucrarea prezintă date de corologie, ecologie şi integrare cenotică a unor specii rare a familiei *Ranunculaceae*, distribuite cu precădere în etajele alpin şi subalpin, şi anume: *Anemone baldensis* L.,

Aquilegia transsilvanica Schur, *Callianthemum coriandrifolium* Reichenb., *Delphinium simonkaianum* Pawl., *Ranunculus glacialis* L., *R. thora* L. şi *Thalictrum alpinum* L.

References

1. BELDIE AL., 1967 - *Flora şi vegetaţia MunţilorBucegi*, Edit. Academiei, Bucureşti.
2. COLDEA GH., 1990 - *Munţii Rodnei. Studiu geobotanic*, Edit. Academiei, Bucureşti.
3. COLDEA GH., 1991 - Prodrome des associations vegetales des Carpates de Sud-Est (Carpates Roumaines. *Document. Phyt.,* **13**:317-539, Camerino.
4. COMAN A., 1946 - Enumerarea plantelor vasculare din Maramureşul românesc din herbarul „A. Coman”, *Bul. Grăd. Bot. şi al Muz. Bot. Cluj*, **26**(1-2):57-89.
5. DRĂGULESCU C., 2003 - *Cormoflora judeţului Sibiu*, Edit. Pelecanus, Braşov, 533 pag.
6. MIHĂILESCU SIMONA, 2001 - *Flora şi vegetaţia Masivului Piatra Craiului*, Edit. Vergiliu, Bucureşti.
7. MITITELU D., AXINTE SILVIA, DORCA MARIANA, 1989 - La flore et végétation de la réserve de Pietrosul Rodnei, *Analele Şt. ale Univ. „Al. I. Cuza”*, **35**:27-31, Iaşi.
8. MITITELU D., CHIFU TH., PASCAL P., 1989 - Flora şi vegetaţia judeţului Suceava, *Anuarul Muz. Jud. Suceava*, 93-120.
9. NYÁRÁDY A., 1953. Fam Ranunculaceae, în *Flora R.P.R.*, vol. II, Edit. Academiei, Bucureşti.
10. PUŞCARIU D. & AL., 1956 - *Păşunile alpine din Munţii Bucegi*, Edit. Academiei, Bucureşti, 511 pag.
11. RAŢIU F., 1982 - Corologia unor specii alpine ale genului Ranunculus în Carpaţii Româneşti, *Contrib. Bot. Cluj-Napoca*, 143-153.

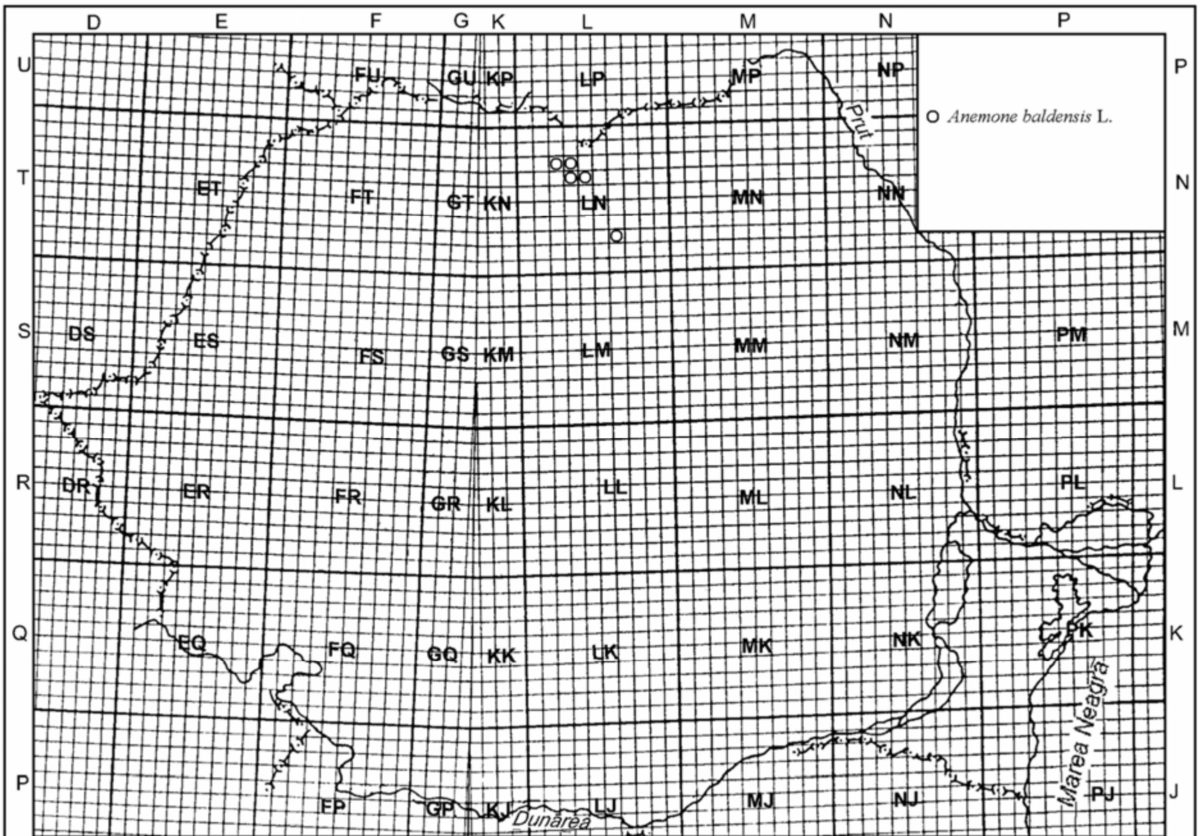

Fig. 1. The chorology of *Anemone baldensis* L. in Romania.

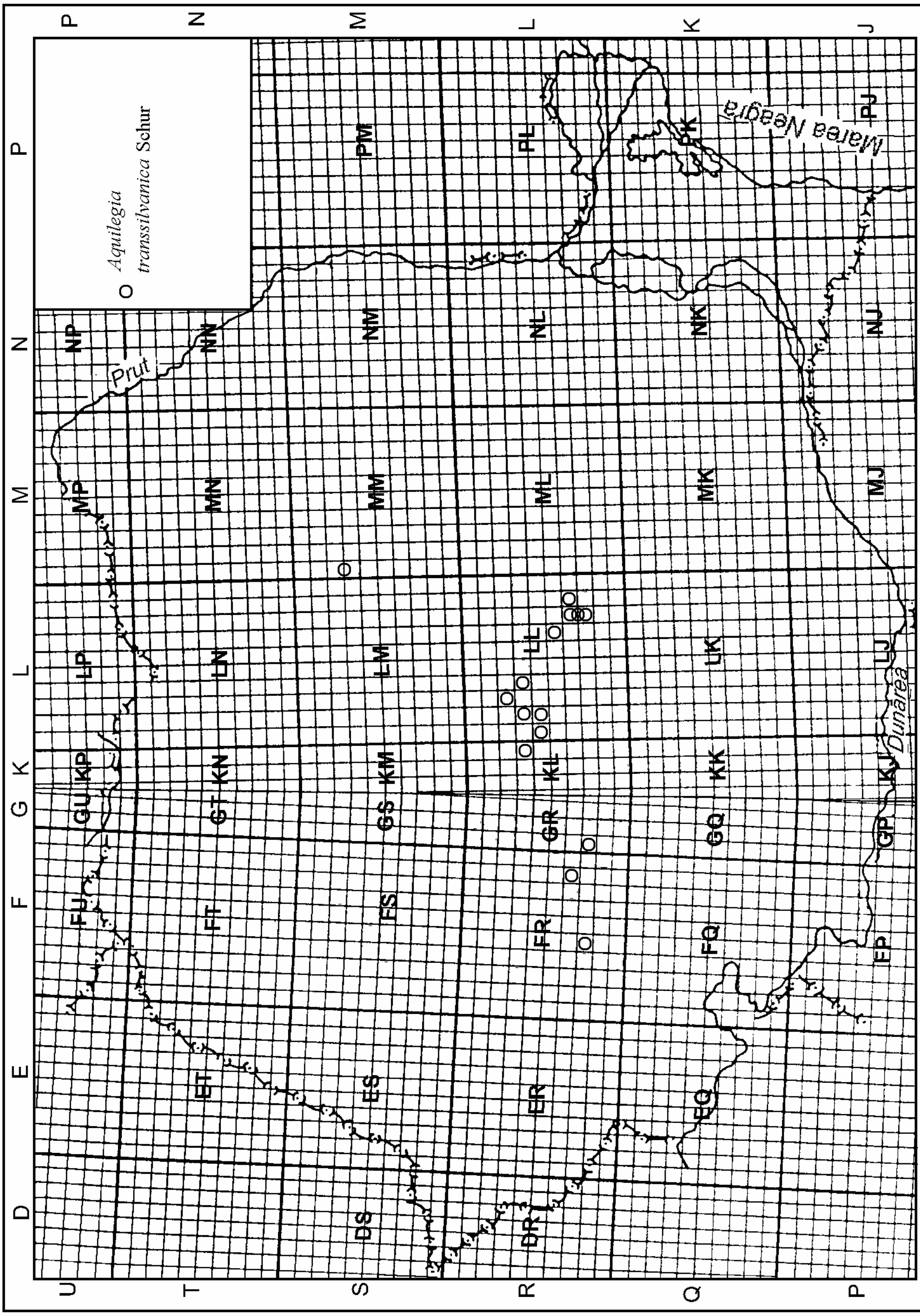

Fig. 2. The chorology of *Aquilegia transsilvanica* Schur in Romania.

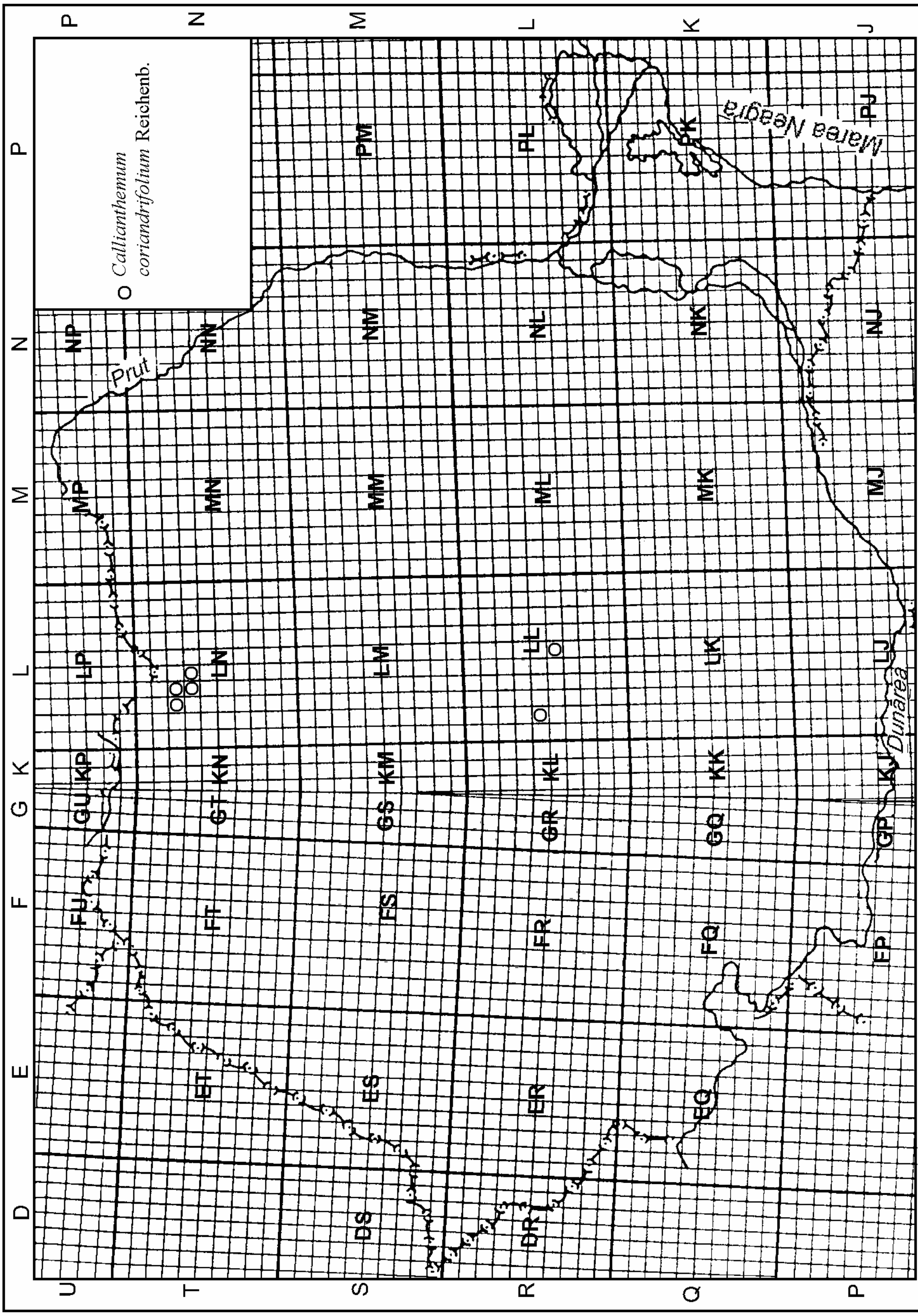

Fig. 3. The chorology of *Callianthemum coriandrifolium* Reichenb. in Romania.

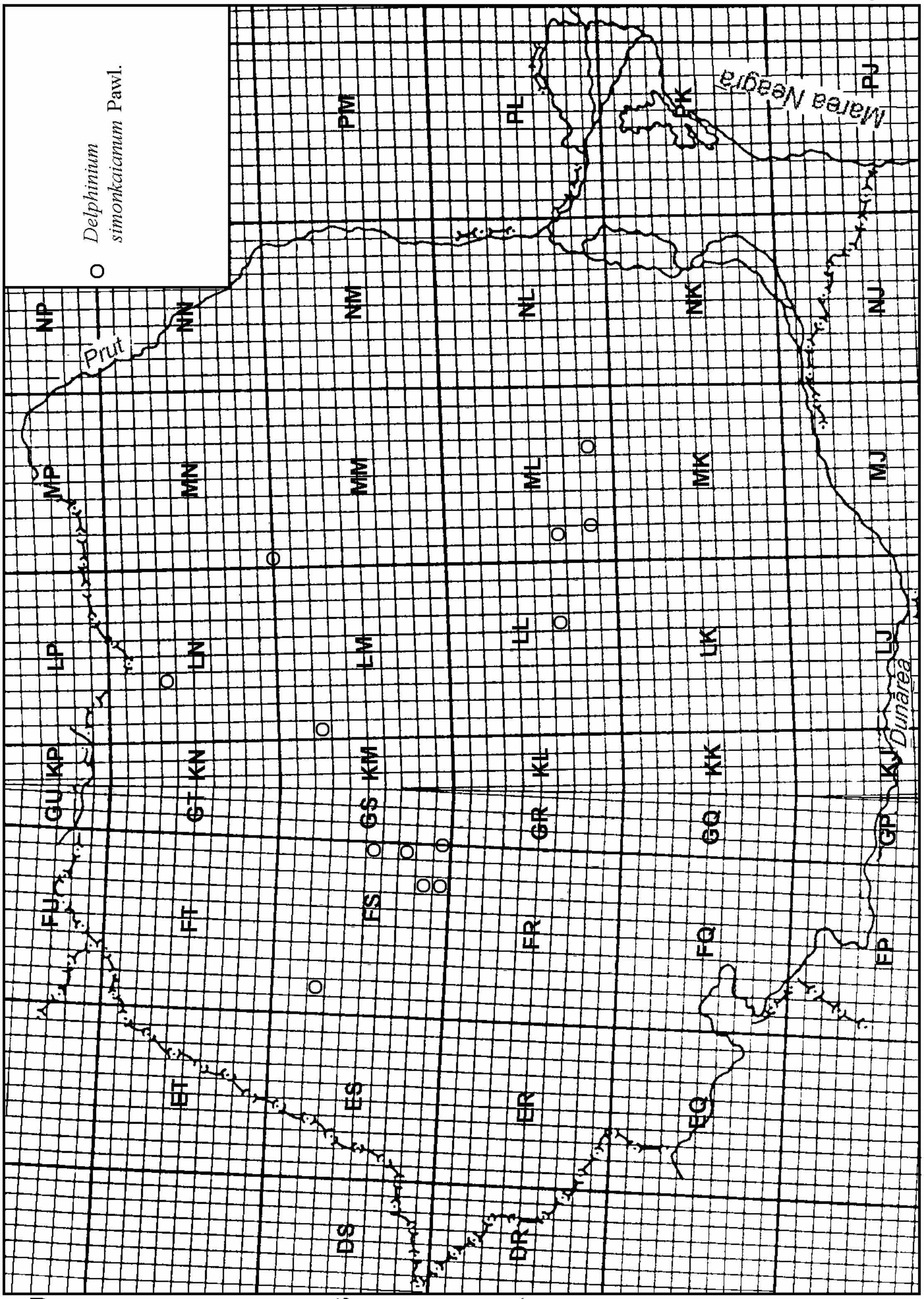

Fig. 4. The chorology of *Delphinium simonkaiamum* Pawl. in Romania.

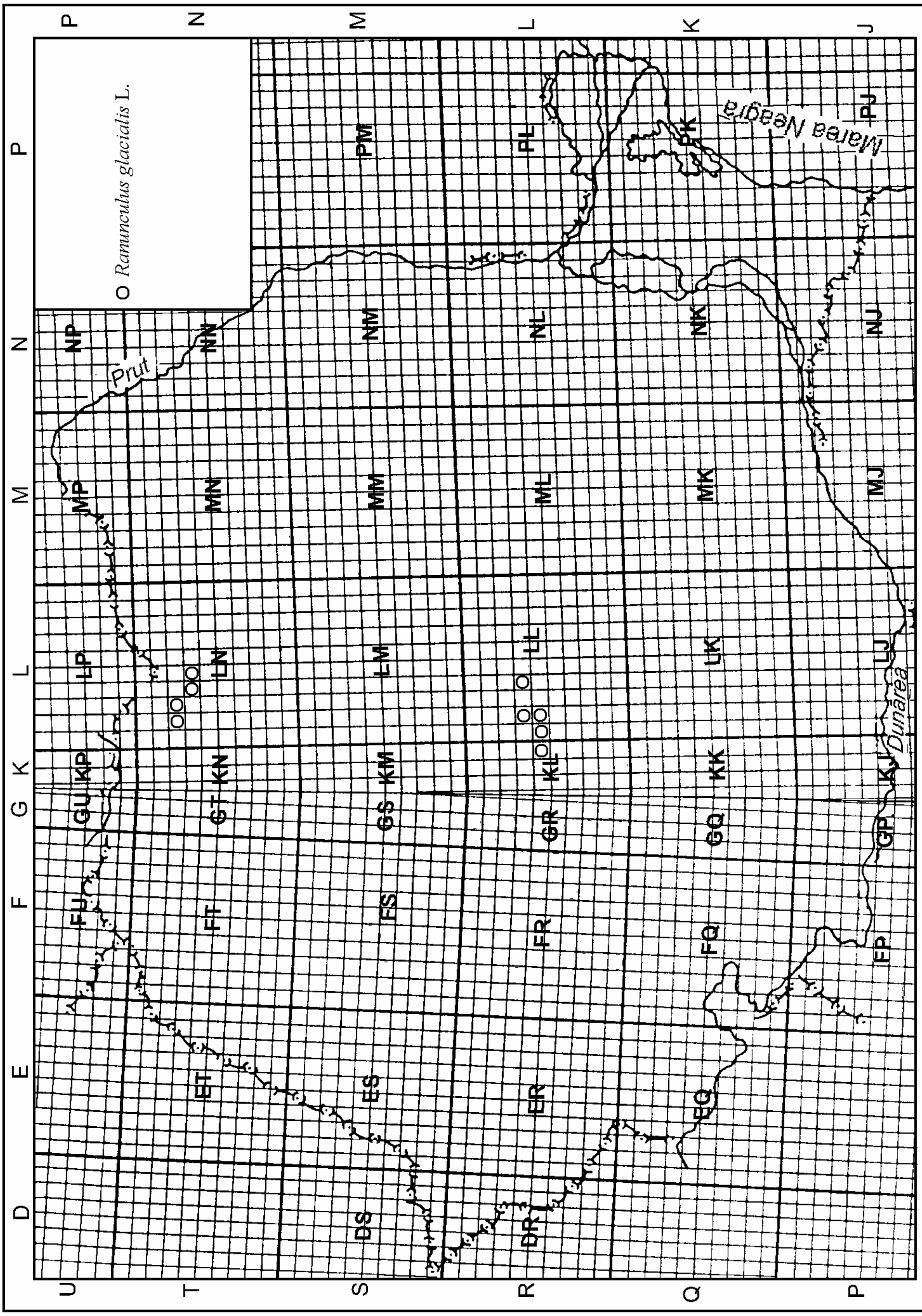

Fig. 5. The chorology of *Ranunculus glacialis* L. in Romania.

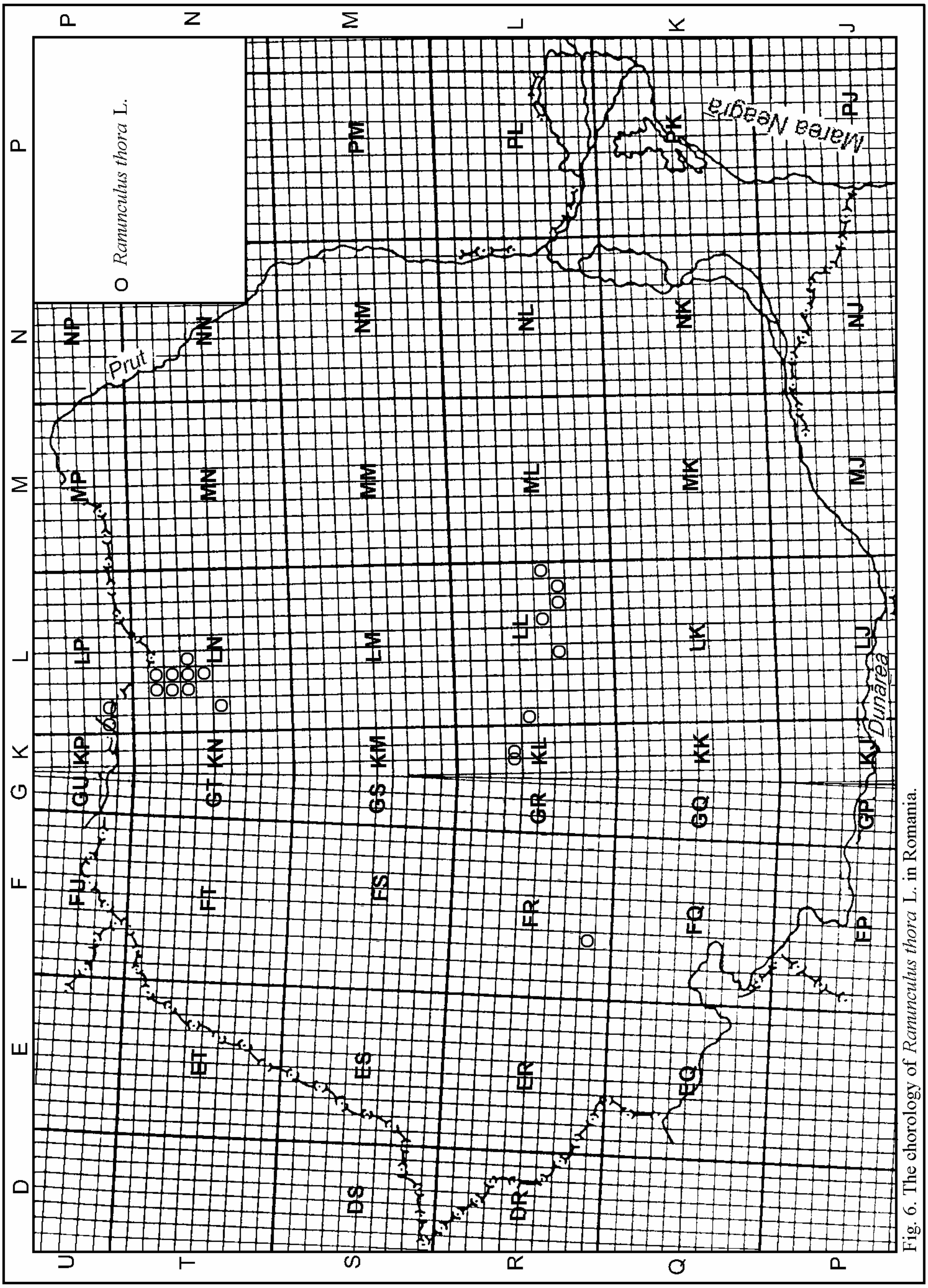

Fig. 6. The chorology of *Ramunculus thora* L. in Romania.

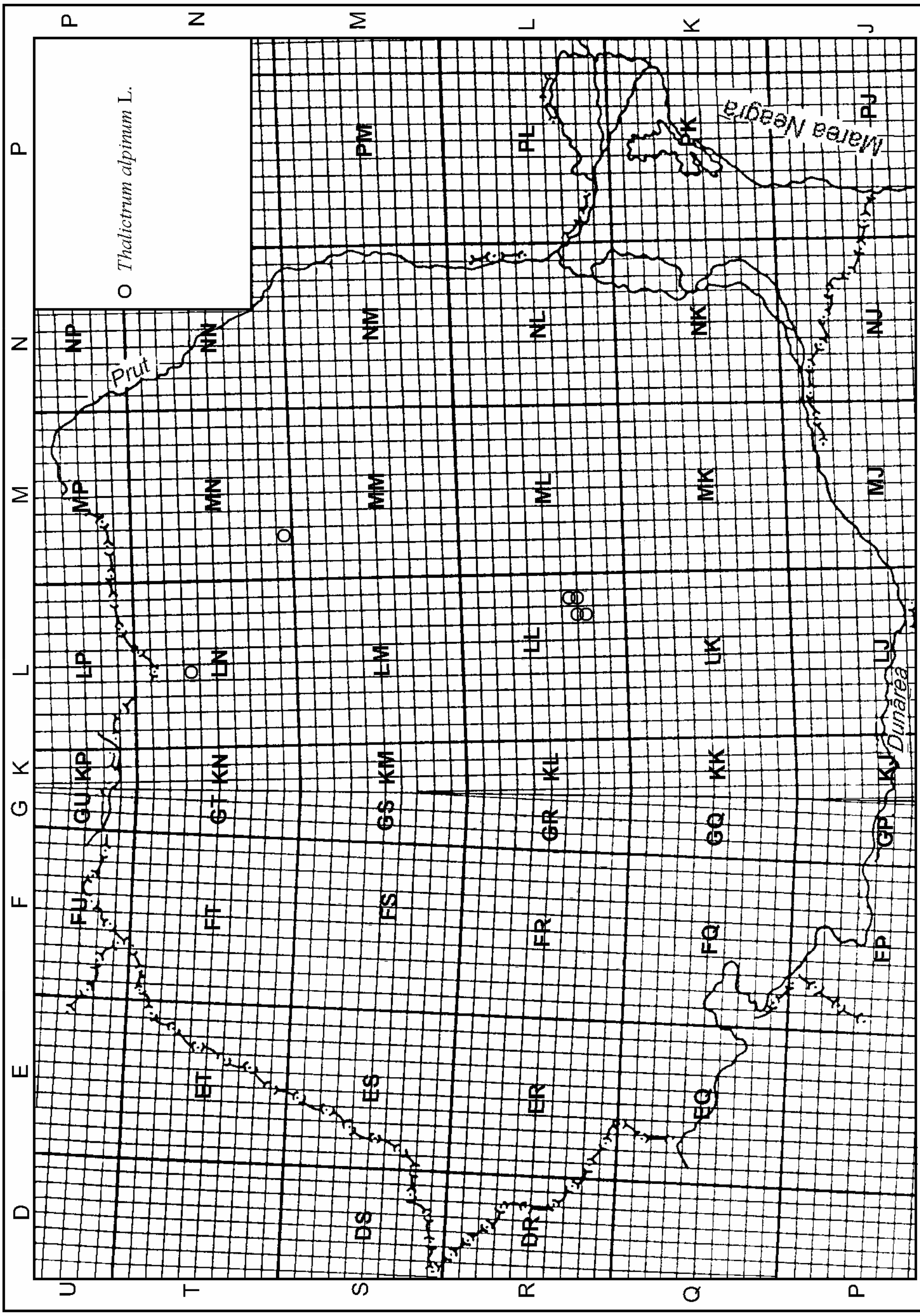

Fig. 7. The chorology of *Thalictrum alpinum* L. in Romania.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

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THE COMPARATIVE ANALISIS OF THE HERBACEOUS LAYER OF OAK AND DURMAST FORESTS OF THE CÂMPIA ROMÂNĂ

CLAUDIA D. BIȚĂ-NICOLAE *, VASILE SANDA*, NECULAI BARABAŞ**

ABSTRACT

BIȚĂ-NICOLAE D.C., SANDA V., BARABAŞ N., 2006 – The comparative analisis of the herbaceous layer of oak and durmast forests of the Campia Română. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 120-123.

There are reviewed four sites: two of oak forests (Călugăreni and Căscioarele forests – *Querco robori-Carpinetum* community) and the other two of durmast forests (Cobia and Sărata Monteoru forests - *Querco petraeae-Carpinetum* community) from the point of view of the herbaceous layer biomass. These studied sites are representative enough for Romanian oak and durmast forests. They are located in the southern-southern-east of the Romanian Plain.

Key words: alder forest, herb layer, fresh biomass, dry biomass.

Introduction

Emphasis on forest herb communities may be particularly relevant in practical applications because this component of the flora is readily accessible to study. It can have an important influence on the long-term development, and it often responds noticeably to variation in resource levels, canopy dynamics, and disturbance (Gilliam *et al.* 1995, Meier *et al*. 1995, Grace 1999). Also, studying diversity in the forest herb community may be important for understanding valued, rare, non-timber forest products because the mechanisms underlying diversity patterns are related to the mechanisms that control population dynamics.

The studied forests are located in the the southern-southern-east of the Romanian Plain.

The forests of *Quercus robur* and *Carpinus betulus* reach a few surfaces in the Câmpia Romȃna, on the brown deep soils, with a rich mull flora. Those of Calugareni are distributed on not excessive declivous slopes 15-25^{o}, north, north-west exposition. The forests of Căscioarele are find on the plan areas.

The forests of durmast (*Quercus petrea*) are found on subcarpathian hills of Muntenia, on soft slopes with south or south-eastern exposition, generally, but north-north-eastern, occasionally (at Sarata Monteoru). It is noticeable in this last forest a strong regeneration of the durmast and a significant presence of the elements of *Symphyto-Fagion* alliance, due to the humidity. The forests of Cobia are found on southern and very sunny slopes; they have a better participation of xerophile trees elements of the *Quercetea pubescentis-petraeae*.

Material and methods

The collection of the vegetal material had been got up seasonally (between may and september in 2005), in order to watch the biomass accumulation, on 0.25 m^2 surfraces, in one hundred repetitions.

In view of determining the biomass quantity on surface unit, a number of 25-50 individuals have been collected, depending on the gravimetric dimensions of plants, which were weighed with the analytic balance, in fresh or dried state (85^{o}).

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Knowing the individual medium weight for every species, as well as their frequency and density an square meter, the quantity of biomass (fresh and dried) on surfrace unit was determined.

Results and discussion

The Călugăreni and Căscioarele forests consist of the *Quercus robus* trees, classified in the *Querco robori-Carpinetum* Borza 1937 association. At these two sites, in the herbaceous layer (fig. 1) there are found the next species: *Viola reichenbachiana* (40% frequency, fresh biomass 646.21 g/m^2), *Brachypodium sylvaticum* (36% frequency, fresh biomass 66.79 g/m^2*, Polygonatum officinale* (42% frequency, fresh biomass 52.36 g/m^2), in Călugăreni forest, *Viola canina* (38 % frequency, fresh biomass 24.74 g/m^2), *Geum urbanum* (24 % frequency, fresh biomass 75.14 g/m^2*, Alliaria petiolata* (17 % frequency, fresh biomass 47.26 g/m^2) in Căscioarele forest. On the other hand, in Cobia and Sărata Monteoru forests the predominant species is *Quercus petraea* framing in association. *Querco petraeae-Carpinetum* Soó et Pócs 1957. The most frecquent species in the herbaceous layer are (fig. 2): *Brachypodium sylvaticum* (37% frequency, fresh biomass 41.28 g/m^2)*, Geum urbanum* (32 % frequency, fresh biomass 29.11 g/m^2*, Campanula trachelium* (11 % frequency, fresh biomass 23.74 g/m^2) in Cobia forest and *Melica uniflora* (29 % frequency, fresh biomass 36.11 g/m^2)*, Glechoma hirsuta* (17% frequency, fresh biomass 24.51 g/m^2)*, Lithospermum purpurocaeruleum* (10 % frequency, fresh biomass 21.84 g/m^2) in Sărata Monteoru forest.

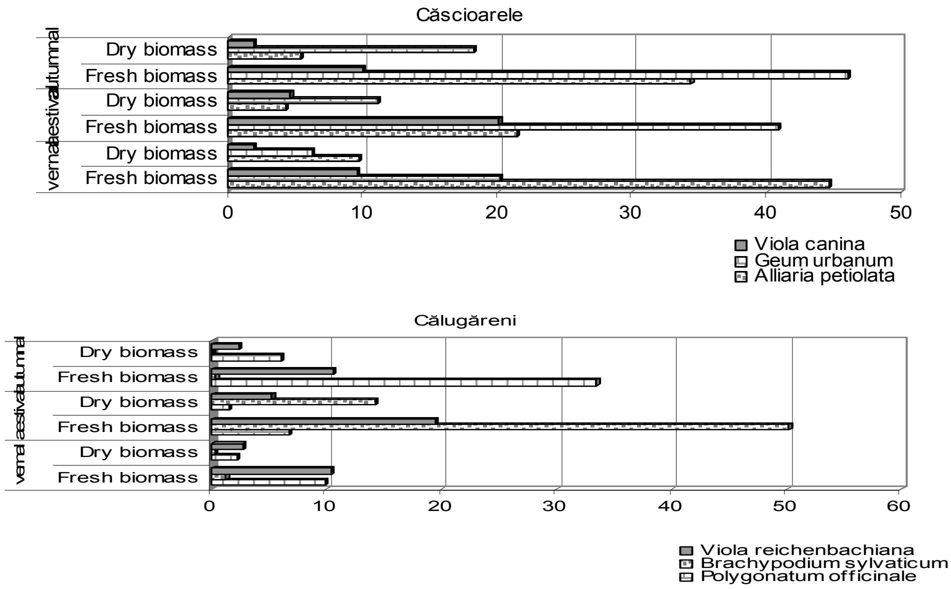
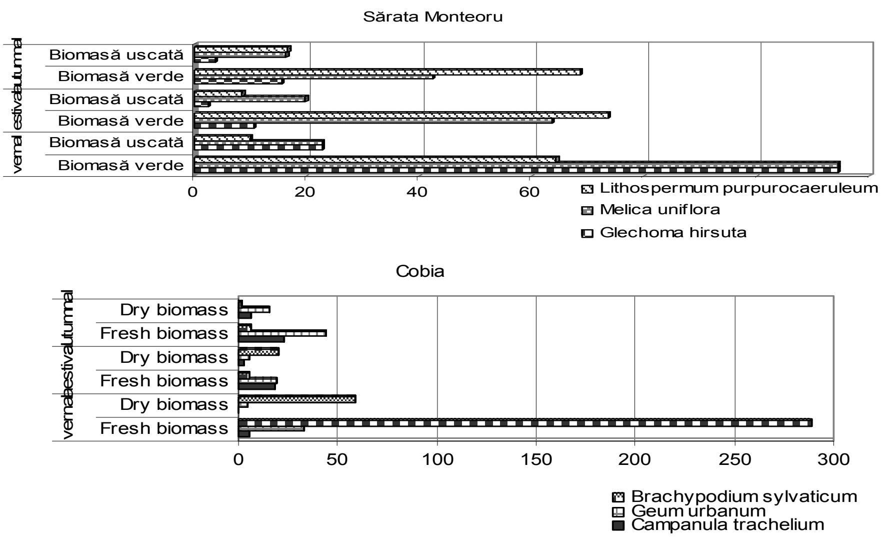
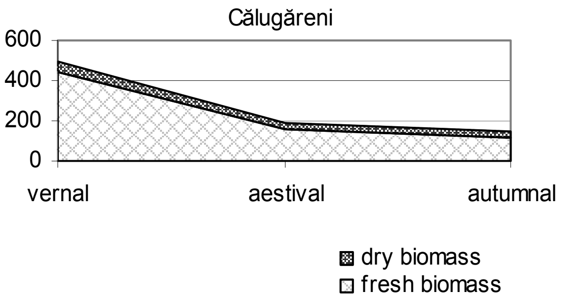


Fig.1 - The dynamics biomass of the predominant herbaceous species in *Querco robori-Carpinetum* associations



The herbaceous synusia, in the fourth sites is not too various and has almost 50-60 cm height and 45-50 % medium average.

According to the graphs (Fig.3) the seasonal dynamics of the herbs biomass of the surface of the studied oakr forests (Călugăreni and Căscioarele forests) emphasizes that the maximum is obtained in the vernal season; due to the abundant precipitation of this year the fresh biomass was 421.211 g/m^2 fresh matter and 69.12 g/m^2 fresh matter, at Călugăreni, 369.398 g/m ^{2} fresh matter and 75.142 g/m^2 dry matter at Căscioarele, respectively.
In both the aestival and autumnal season, the biomass decreases to almost a half: 230.11 g/m ^{2} fresh matter and 36.62 g/m^2 dry matter and 190.35 g/m^2 fresh matter and 34.031 g/m^2 dry matter at Călugăreni, but 170.094 g/m^2 fresh matter and 54.142 g/m^2 dry matter and 155.675 g/m^2 fresh matter and 45.785 g/m^2 dry matter at Căscioarele.



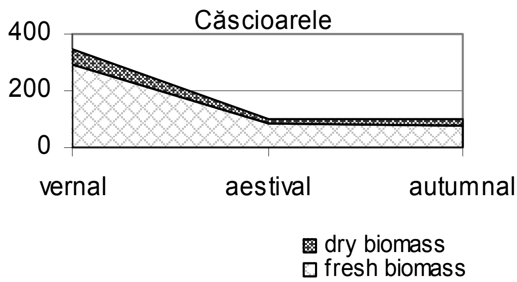
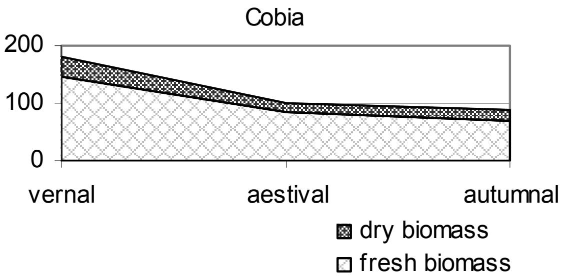


Fig. 3 - The dynamics of herb biomass of oak forests of *Querco robori-Carpinetum* associations

In the association of the other two sites (Cobia and Sărata Monteoru) framed in *Querco petraeae-Carpinetum* the seasonal dynamics of the herbs biomass (Fig.4) emphasizes that in the vernal season the fresh biomass was 155.501 g/m ^{2} fresh matter and 49.098 g/m ^{2} dry matter at Cobia, 315.406 g/m ^{2} fresh matter and 106.959 g/m^2 dry matter at Sărata Monteoru, respectively.
Because of the lack of precipitations of this year but later than in the field area, in the aestival season the biomass decreases to 125.248 g/m ^{2} fresh matter and 56.315 g/m^2 dry matter at Cobia and 190.35 g/m ^{2} fresh matter and 84.031 g/m^2 dry matter at Sărata Monteoru.
In the autumnal season, the biomass is almost at the same value, 98.423 g/m ^{2} fresh matter and 31.596 g/m^2 dry matter but it increases at Sărata Monteoru due to local conditions at 302.675 g /m ^{2} fresh matter and 71.785 g/m^2 dry matter.



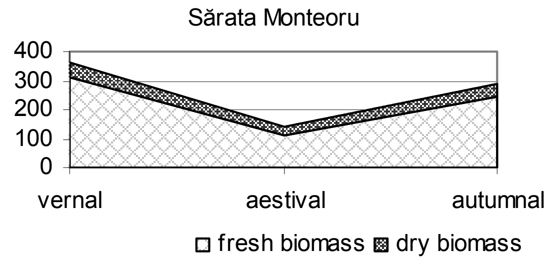


Fig. 4 - The dynamics of herb biomass of durmast forests of *Querco petraeae-Carpinetum* associations.

Conclusions

Although the mechanisms that produce the classical unimodal diversity-productivity relationship are evident in the vegetation structure of this system, the observed relationship between species richness and productivity has a monotonic increase rather than a unimodal pattern.

Furthermore, species distributions fail to show strong evidence that the competition among understory species acts as a mechanism to reduce diversity at high productivity. Intra-seasonal dynamics of the various above-ground primary producer compartments for the four forest sites presents a significant difference.

The seasonal peak values of the primary producer compartments are examined as indicative of the net accumulation of organic material, and the relationships of these peak values to various abiotic regimes at the sites investigated.

It could be noticed the varied accumulations of biomass among the studied sites. Thereby, through the differences among the existent abiotic factors in these four sites (temperature, precipitations, exposure) that could be explained.

Rezumat

În lucrarea de față sunt analizate patru situri (pădurea Călugăreni, Căscioarele, Cobia şi Sărata Monteoru) din punct de vedere al productivității stratului ierbos.

Siturile luate în studiu sunt păduri reprezentative din silvostepa României şi se găsesc în partea de sud-sud-est a Câmpiei Române.

De asemenea, pentru fiecare din cele patru situri a fost prezentată dinamica biomasei sezoniere pentru unele specii din sinuzia ierboasă.

După efectuarea studiului analizei stratului ierbos s-a pus în evidență faptul că maximum este atins în sezonul vernal, în timp ce în sezonul estival şi autumnal biomasa scade foarte mult.

References

1. ABRAMS P. A., 1995 - *Monotonic or unimodal diversity-productivity gradients: what does competition theory predict?* Ecology, 76: 2019-2027.
2. DUFFY C. D., MEIER A. J., 1992 - *Do Appalachian herbaceous understories ever recover from clearcutting ?* Conserv. Biol., 6: 196-201.
3. GILLIAM F. S. TURRILL N.L., 1993 - *Herbaceous layer cover and biomass in a young versus a mature stand of a central Appalachian hardwood forest.* Bull. Torrey Bot. Club, 120: 445-450.
4. GILLIAM F. S., TURRILL N.L., ADAMS M. B., 1995 - *Herbaceous-layer and overstory species in clear-cut and mature central Appalachian hardwood forests.* Ecol. Appl. 5: 947-955.
5. GRIME J. P., 1973 - *Competitive exclusion in herbaceous vegetation.* Nature, 242: 344-347.
6. GRACE J. B., 1999 - *The factors controlling species density in herbaceous plant communities: an assessment.* Perspect. Plant Ecol. Evol. Syst. 2: 1-28.
7. PAUSAS J. G., AUSTIN M. P., 2001 - *Patterns of plant species richness in relation to different environments: an appraisal.* J. Veg. Sci., 12: 153-166.
8. SANDA V., 2002 - *Vademecum ceno-structural privind covorul vegetal din România*. Editura Vergiliu, Bucureşti, 331 pg.
9. TILMAN D., PACALA S., 1993 - *The maintenance of species richness in plant communities,* p. 13-25. In: R. E. Ricklefs and D. Schluter [eds.], Species diversity in ecological communities: historical and geographical perspectives. University of Chicago Press, Chicago, IL.

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THE ECOSYSTEMIC STUDY OF THE PEDUNCULATE OAK (*QUERCUS ROBUR*) SOUTH PART OF THE ROMANIAN PLAIN

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ABSTRACT

SANDA V., VASILIU-OROMULU L., PAUCA-COMANESCU M., BARABAS N., FALCA M., HONCIUC V., MAICAN S., STANESCU-MANU M., ONETE M., BITA-NICOLAE C., FIERA C., ŞINCU D.E., ION M., 2006 - The ecosystemic study of the pedunculate oak (*Quercus robur*) South part of the Romanian Plain. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 124-137.

Within the Quercus forests, there are characteristic species to the order ***Fagetalia*** and to the class ***Querco-Fagetea*** which forms the vegetation background; can be find also some thermophilous elements belonging to the class ***Quercetea pubescenti-petraeae*** like: *Lithospermum purpurocaeruleum, Tamus communis* and *Polygonatum odoratum*. The invertebrate fauna is dominant at Căscioare site, while the anthropic impact was much stronger in the tree forests at Călugăreni.

Key words: ecosystemic study, *Quercus robur*, Romanian plain

Introduction

The pedunculate oak forests are found in the plain area between 75-150 m altitude, on alluvial soils, in different degrees of evolution, they compose the forest vegetation of alluvial plains in here enter many mesohygrophilous species and the shrub layer is dominant by *Cornus mas* and herbaceous layer by many hygrophylous elements: *Brachypodium sylvaticum, Lysimachia nummularia* and *Lamium galeobdolon*.

In the herbaceous layer at Călugăreni *Ruscus aculeatus* is a relevant species, considered a rare species (Habitats Directive) and endangered species (IUCN) pick up in the past for trading and found now only as some plagiotropic bushes.

In the vernal season, the species *Allium ursinum* shows a high quantity of humus in the soil.

There are contributions of oak forests of the Romanian Plain by Borza Al. (1963), Popescu A. et al. (1984), Cârţu D. (1971), Sanda V., Popescu A. (1971).

They relieve the structure, distribution and more accentuated anthropic impact of pedunculate oak forests in the last decade.

Material and methods

Querco robori-Carpinetum Borza 1937, formed by *Carpinus betulus* and *Quercus robur* are well represented in the Romanian Plain. The phytocoenosis from Călugăreni are installed on slopes with a North-North-East exposure, having a medium slope of 10-15°.

The soil is forest brown, light acid, which facilitates the development of an herbaceous layer, dominated by thermal meso-thermal elements.

The density and the dendrometric measurements of the trees were determined on circular areas of 500 sq.m; tree diameter was determined with a scaled ruler, their height was

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determined by direct measurements with the Bitterlich relascope and also by the specific curves of regression. The volume of wood was calculated with the tables of production.

The indices of frequency, density and biomass of the herbaceous species were determined using sampling areas of 50/50 cm, in 10 replicates.

The fauna of invertebrate from the canopy and the herbaceous layer was collected with the entomologic net of 60 ø cm and 30 ø cm in diameter, 10 samples each; the mobile fauna from the soil surface being captured with Barber traps, 9 samples of each; for centipedes using samples 25/25 cm, 10 samples each; the edaphic fauna of Nematoda, Enchytraeidae, Collembola and Acari was sampled with a MacFadyen probe, 10 samples for each group of organisms; the lumbricides were collected on 10 areas of 25/25 cm.

Results and discussions

In the forest layer, besides the two co-dominants one can also find *Tilia tomentosa, Acer platanoides, A. campestre* and *Fraxinus excelsior.* The forests consistency is of 0.7-0.8, having a medium covering of 75-80%.

The species *Ruscus aculeatus* had a less spread population, due to abusive cut done by the local population. As specific particularities, we remark the domination of the species *Allium ursinum* in the spring within the phytocoenosis at Călugăreni and a more consistent forest layer mainly formed by *Cornus mas* within the ones at Căscioarele. The herbaceous layer with a reduced presence, were formed by elements of mull flora, like: *Ranunculus ficaria, Lamium galeobdolon, Alliaria petiolata*, etc.

The anhtropic influence is strong and it consists of extracting valuable essences and of intensive pasturing, such that on many portions one can meet species that indicate a high quantity of nitrate in the soil, such as: *Urtica dioica* and *Parietaria officinalis.*

The forests enlightened by pedunculate oaks have a high composition diversity of trees layer dominated quantitatively by hornbeam and lime. The trees density is low because of their advanced age. Due to competition for light, the canopy stratification is on wide range of height.

The development of shrubs layer is higher especially in Căscioarele forest, where the old trees are scarcer having more opened canopy. The diversity and quantity of young trees (offshoots) individuals are higher and the youngsters of hornbeam population are in expansion.

Tab.1 - Ecological characterization of trees and shrubs layer

Sărata Monteoru		Cobia	
Querco petraea – Carpinetum Soó et Pócs57			
Density: 530 ind/ha		Density: 1420 ind/ha	
Mature forest, over 100 years		Young forest (35 years) regenerated from offshoots	
Species present	Species ratio %	Species present	Species ratio %
Trees		Trees	
Quercus petraea	16	*Quercus frainetto*	7,5
Carpinus betulus	77	*Quercus cerris*	6
Fagus sylvatica	5	*Quercus robur*	7
Acer campestre	2	*Ulmus minor*	6
		Acer campestre	6
Shrubs		Shrubs	
Cornus sanguinea	60	-	-
Carpinus betulus	32	-	-
Viburnum lantana	4	-	-
Fagus sylvatica	4	-	-

Tab. 2 - *Querco robori-Carpinetum* Borza 1937

No. survey	1	2	3	4	5	6	7	8	9	10	11	12	K
Height veget. - trees	25	30	20	25	30	30	28	25	28	25	28	25	
- shrubs	10	6	10	10	10	8	7	10	8	10	10	10	
- herbaceous	30	40	50	40	50	60	75	30	40	40	60	60	
Coverage (%) - trees	85	80	75	80	85	85	80	80	85	80	80	85	
-shrubs	10	8	10	10	10	10	20	20	15	20	25	20	
-herbaceous	65	60	50	50	50	50	20	25	15	20	15	15	
Surface (m^2)	500	500	500	500	500	500	500	500	500	500	500	500	
Car. ass.													
Carpinus betulus	2	2	2-3	2	2	2	1-2	1-2	1	1-2	1-2	1-2	V
Quercus robur	3	3	3	3	3	3	4	4	4	4	4	4	V
Arum orientale	+	+	1	+	+	+	+	+	+	+	+	+	V
Tilia tomentosa	1		+1	+	1		+	+	+1	+	+1	1	V
Lathyro halerstenii-Carpinenion													
Rumex sanguineus	+		+		+	+1	+	+		+	+	+	IV
Carex remota	+	+		+		+		+	+		+		III
Geum urbanum		+		+			+			+		+	III
Polygonatum latifolium		+	+		+		+	1		+		+	III
Ligustrum vulgare		+					+	+		+		+	III
Fagetalia sylvaticae													
Carex sylvatica	+		+		+		+				+		III
Galium odoratum		+	+	+		+							II
Lamium galeobdolon	+		+	+		+	+		+		+	+	IV
Viola reichenbachiana		+1		+	+		+		+	+	+	+	IV
Allium ursinum	3	2		+				+	+				III
Lathraea squamaria		+	+		+				+			+	III
Asperula taurina		+	+			+							II
Querco – Fagetea													
Euonymus europaeus									+		+	+	II
Asparagus tenuifolius							+		+	+			II
Acer campestre	+	+		+		+	+	+	+	+	+	+	IV
Crataegus monogyna	+1		+1		+		+1	1-2	1-2	+	+1	1	IV
Ranunculus ficaria		+1		+	+	+1		+	+1		+	+	IV
Corylus avellana	+	+	+		+	+	+	+	+	+	+	+	V
Alliaria petiolata	+		+		+	+		+			+		III
Acer platanoides		+	+		+					+	+	+	III
Astragalus glycyphyllos	+		+			+		+		+			III
Brachypodium sylvaticum		+	+		+		+	+	+	+		+	IV
Ruscus aculeatus	+	+		+	+	+							III
Geum urbanum	+		+		+			+	+			+	III
Quercetea pubescenti-petraeae													
Lithospermum purpurocaeruleum								+	+		+	+	II
Tamus communis								+		+	+	+	II
Cornus mas	+		+		+		+		+				III
Polygonatum odoratum							1-2	+1	1				II
Variae Syntaxa													
Stellaria media		+	+		+								II
Urtica dioica		+		+			+	1-2	+			+	III

1-2 surveys: 2: *Euphorbia amygdaloides*, 3: *Anemone ranunculoides*, *Scilla bifolia*, 5: *Veronica hederifolia*, 6: *Carex remota*, *Galium aparine*, *Dentaria bulbifera*, 7: *Chelidonium majus*, 8: *Fraxinus excelsior*, 9: *Ulmus minor*, 10: *Lysimachia nummularia*, 11: *Rosa canina*, *Parietaria officinalis*.

The places and the date: Călugăreni, 1-2: 9.05.2005; 3-4: 5.07.2005; 5-6: 9.09.2005.
Căscioarele, 7-8: 10.05.2005; 9-10: 7.07.2005; 11-12: 10.09.2005.

The seasonal dynamics of the herbaceous biomass presents maximal values in both sites during the vernal season; the biomass decreases at almost half during the summer and autumnal season. The high variance in the biomass of the herbaceous layer is due to the heavy falls in the winter season and the long time heat that followed in the other seasons (Fig. 1).

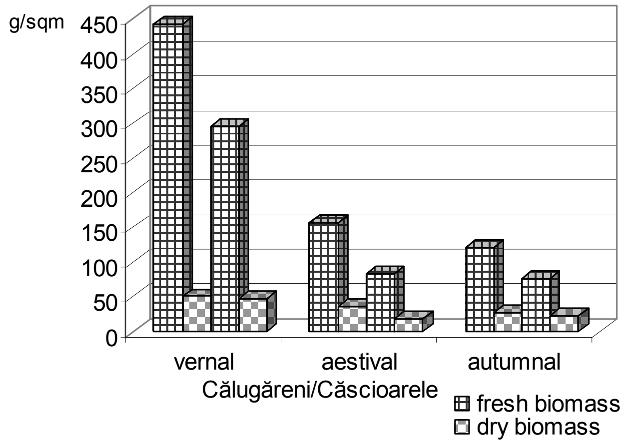

Fig. 1. - The seasonal dynamics of the herbaceous biomass accumulation.

In the studied areas, there were collected a number of 19 macromycetes species, a high number of specimens items of *Amanita* genus being remarked. Among the found species we mention: *Lycoperdon perlatum, Amanita vaginata* var. *grisea, Amanita vaginata* var. *nivalis*, *Leccinum crocipoium, Gymnopus fusipes, Schizophyllum commune, Daedalea quercina, Xylaria polymorpha* and species of the genus *Russula* and *Inocybe.*

The invertebrates that live in the ample canopy of the pedunculate oak forests are dominant at Călugăreni, compared to the ones at Căscioarele from numerical and biomass abundance point of view.

If during the spring the microarthropods are represented by more than 11-12 groups of invertebrates, during the summer and autumn there are only 6 suprataxa in both sites, which proves a more homogeneous dynamics. The significant difference is relevant with regard to the numerical abundance, with 100 individuals greater at Călugăreni than at Căscioarele.

At Călugăreni, the wider and richer canopy ensures an optimal microhabitat for canopy invertebrates (Figs. 2; 3).

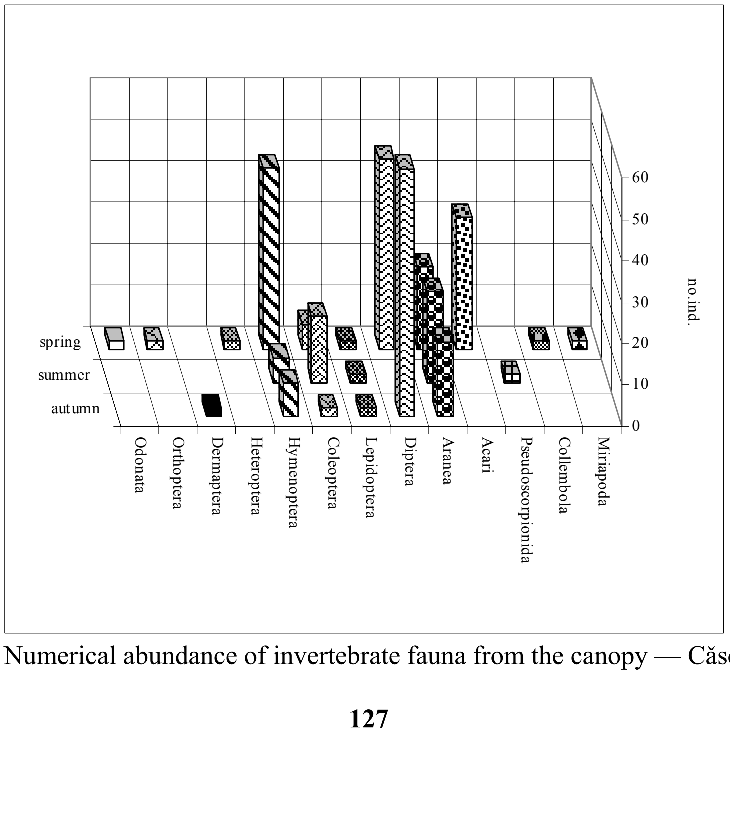

Fig. 2 - Numerical abundance of invertebrate fauna from the canopy — Căscioarele

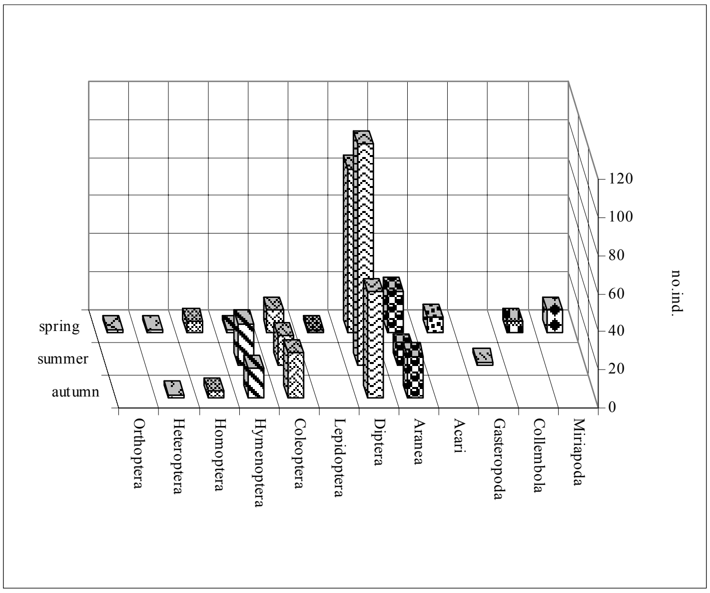

Fig. 3 - Numerical abundance of invertebrate fauna from the canopy — Călugăreni

At Căscioarele, the herbaceous layer is inhabited by a rich invertebrate zoocoenoses also due to the plane surface and to the height of vegetation. The peak of the temporal dynamics was in summer (248 ind/m^2), being determined by 10 groups of organisms dominated by coleopterans (Fig. 4).

The presence of Orthopterans, Thysanoptera, Hymenopterans, indicates a balanced, coenosis with a high dinamycs.

At Călugăreni, during spring time, the domination of Homeoptera (aphides) and Diptera show the action of the anthropic impact (Fig. 5).

During autumn, at Căscioarele the ratio fitofagous/zoofagous relieve an active zoocoenoses; Heteroptera, Homoptera, Hymenoptera and Coleoptera have a similar relative abundance, so there is a uniform repartition of the resources among these invertebrate groups.

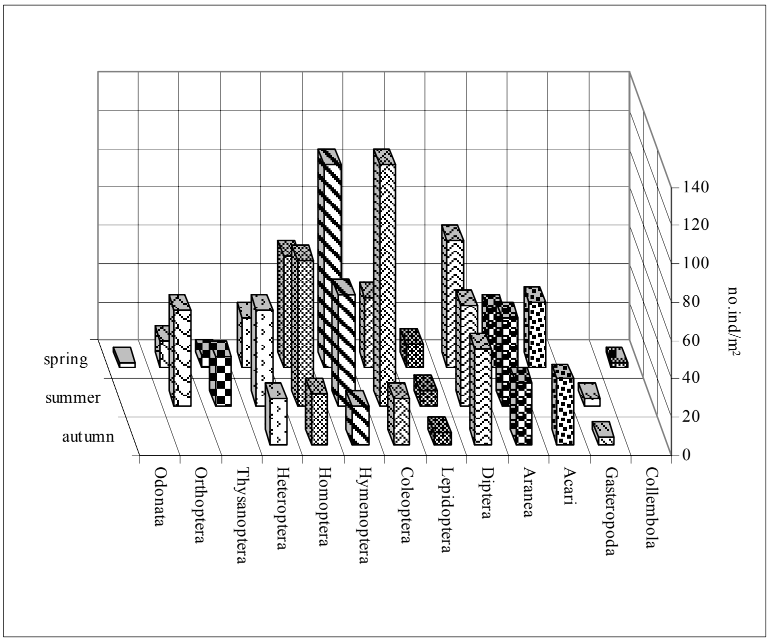

Fig. 4 - Numerical density of invertebrate fauna from the herbaceous layer –Căscioarele

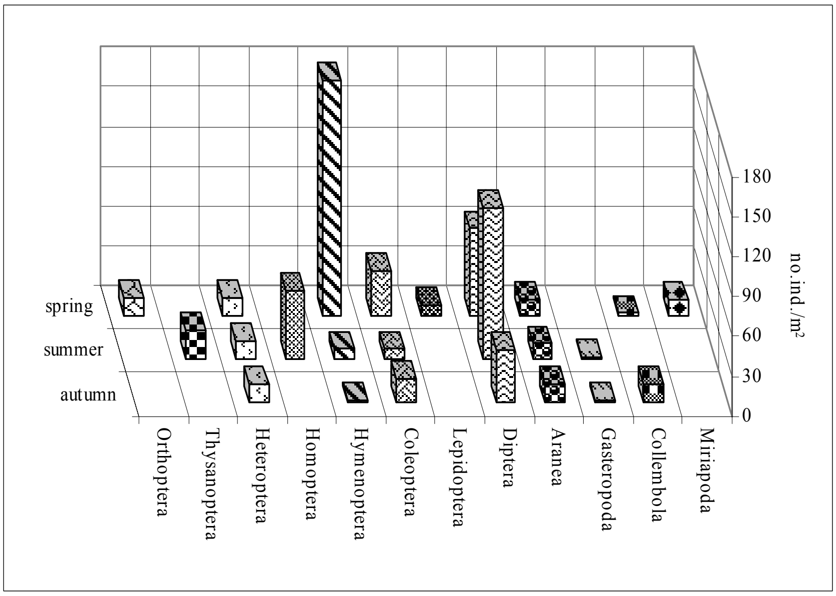

Fig. 5 – Numerical density of invertebrate fauna from the herbaceous layer - Călugăreni

The thrips coenoses is wider at Căscioarele, compared to the one at Călugăreni site. 10 species in the summer time, in the herbaceous layer of the oak forests at Căscioarele, with a density of 84 ind/m^2 with a CV, in general of 224, comprises a biomass of 67.2 mg wet matter/m^2 (Tab. 2).

The intensive energetical metabolism is represented by a high value of 1.68 ml O_2/m^2.

The majority of the species identified at Căscioarele are typical praticolous: *Aptinothrips rufus, A. elegans* and *A. stylifer* (apterous), *Chirothrips ruptipennis, Frankliniella intonsa* and *Limothrips denticornis.* The diversity Shannon-Wiener index, of 2.52 represents an average value and the equitability is of over 75%.

At Călugăreni, this diversity index is very low 0.65 and the equitability reaches only 65% (Tab. 3).

Tab. 3 - The structural and functional indices of the Thysanoptera populations (sweepings)

Călugăreni-summer	- x/m^2	s^2	STDEV	s'	CV	f.w/ m^2	d.w./ m^2	energ.metab. ml O_2/m^2	A%	C%	$p_i \log p_i$
Anaphothrips atroapterus	4	0.8	0.9	0.18	224	3.20	0.40	0.08	16.67	20	-0.130
Thrips fuscipennis	20	20.0	4.5	0.89	224	16.00	2.00	0.40	83.33	20	-0.066
□	**24**	18.8	4.3	0.87	181	**19.20**	**2.40**	**0.48**	100		-0.196
		H(S)	**0.65**		**H_{max}**	**1**	**E%**	**65.00**			
Căscioarele-spring											
Thrips tabaci	4	0.8	0.9	0.18	224	3.20	0.40	0.08	100	20	0
□	**4**	0.8	0.9	0.18	224	**3.20**	**0.40**	**0.08**	100		0
		H(S)	**0**		**H_{max}**	**0**	**E%**	**0**			
summer											
Anaphothrips atroapterus	2	0.2	0.4	0.09	224	1.60	0.20	0.04	2.50	20	-0.040
Aptinothrips elegans	2	0.2	0.4	0.09	224	1.60	0.20	0.04	2.50	20	-0.040
Aptinothrips rufus	34	27.8	5.3	1.05	155	27.20	3.40	0.68	42.50	40	-0.158
Aptinothrips stylifer	4	0.8	0.9	0.18	224	3.20	0.40	0.08	5.00	20	-0.065
Chirothrips ruptipennis	10	5.0	2.2	0.45	224	8.00	1.00	0.20	12.50	20	-0.113
Frankliniella intonsa	12	7.2	2.7	0.54	224	9.60	1.20	0.24	15.00	20	-0.124
Limothrips denticornis	2	0.2	0.4	0.09	224	1.60	0.20	0.04	2.50	20	-0.040

Thrips tabaci	10	2.0	1.4	0.28	141	8.00	1.00	0.20	12.50	40	-0.113
Haplothrips aculeatus	6	0.8	0.9	0.18	149	4.80	0.60	0.12	7.50	20	-0.084
Haplothrips leucanthemi	4	0.8	0.9	0.18	224	3.20	0.40	0.08	5.00	20	-0.065
□	**80**	12 1.5	1 1.0	2.20	138	**64.00**	**8.00**	**1.60**	100		-0.758
		H(S)	**2.52**		**H_{max}**	**3.32**	**E%**	**76**			

The study of the specific biodiversity to the coleopteran fauna in the oak forests at Călugăreni and Căscioarele shows the presence of some species belonging to the families **Chrysomelidae, Coccinellidae, Cerambycidae** and **Lucanidae**.

Thus, the taxon structure of the coleopteran fauna at Căscioarele, in the herbaceous layer, includes the following species with feed preferences, in general mesophilous: *Clytra laeviuscula, Cryptocephalus moraei, Cryptocephalus octacosmus, Cryptocephalus parvulus, Cryptocephalus bipunctatus, Cryptocephalus sericeus, Cryptocephalus hypochoeridis, Pachybrachis sinuatus, Chrysolina polita, Chrysolina varians, Chrysolina staphylaea, Chrysolina herbacea, Cassida viridis, Cassida ubiginosa, Pilemostoma fastuosa* (Chrysomelidae) and *Coccinella septempunctata* (Coccinellidae)

The coleopteran fauna in Călugăreni forest, compared to the one at Căscioarele, have been less represented, being identified species belonging to the families Chrysomelidae (with the species *Chrysolina fastuosa, Oulema melanopus, Aphtona venustula),* Cerambycidae (*Rosalia alpina*) and Lucanidae (*Lucanus cervus* and *Dorcus parallelopipedus*)

Lucanus cervus Linnaeus (Lucanidae) – lives especially in the folded forests (especially oak), but it can be also met in the forest step areas; status according IUCN; species with low risk (LR); included in the addenda of Bern convention as a rare species, threat with extinction.

Rosalia alpina Linnaeus (Cerambycidae) – an exemplar probably brought from the mountain area together with the cut logs; is met in the climate context of beech and coniferous forests, and less in the oak and ante step context; the larva develop in the wood of old oaks (*Fagus sylvatica, Fagus orientalis*); status according to IUCN; species in critical stage (CR); included in the addenda of Berna convention as a rare species, threat with extinction.

The invertebrate fauna in the soil

The fauna of chilopodes in the litter presents a number of individuals much higher in the forest at Căscioarele than in the one at Călugăreni. The Geophilomorpha order is weakly represented (only 6% of the collected effective) from the Lithobiomorpha order being presented only species belonging to the genus *Lithobius.*

No high variation in the number of individuals collected during summer and autumn has been found, opposite to the data in the literature that indicate a significant increase of the epigeical activity (and so of the number of captured individuals) during autumn, under the normal climatic conditions of one year (Tuf. I.H., 2000). We may suppose that the humidity played an important role, because the choice of the micro habitat at chilopodes is governed by physical factors, high humidity, low light intensity and a uniform temperature (Eason E.H., 1964)

In the soil of the two oak forests, the nematodes have a medium representation; in the spatial dynamics there is a majority at Căscioarele; in the temporal dynamics, during spring at Călugăreni and during summer at Căscioarele, function of the microspecific conditions, the values of the numerical density are almost the same (Tab. 4).

The relative abundance of the nematodes is more diminished in S_2 at Călugăreni, with a seasonal variation of 12.11%-29.69%; 13.38%-17.48% at Căscioarele.

The biomass density proves a more intense bioacumulation at Călugăreni, and a much lower one at Căscioarele.

The decrease in the numerical values of the nematodes, during summer, at Călugăreni is within the normal curve representing the seasonal dynamics for these worms.

Decomposing the litter, they activate in synergy with the microbiota, their common effect being much more important.

Tab. 4 - The structural indices of nematoda fauna

Călugăreni-spring	x/m^2	s^2	STDEV	s'	mg/m^2	A%
L	173600	5226.80	72.30	14.46	8.68	52.57
S_1	104400	1356.80	36.83	7.37	5.22	31.62
S_2	52200	682.70	26.13	5.23	2.61	15.81
Σ	**330200**	15797.70	125.69	25.14	**16.51**	100.00
summer						
L	42200	855.70	29.25	5.85	2.11	32.97
S_1	47800	334.70	18.29	3.66	2.39	37.34
S_2	38000	223.50	14.95	2.99	1.90	29.69
Σ	**128000**	2309.00	48.05	9.61	**6.4**	100.00
autumn						
L	146800	3214.70	56.70	11.34	7.34	58.49
S_1	73800	1215.70	34.87	6.97	3.69	29.40
S_2	30400	670.30	25.89	5.18	1.52	12.11
Σ	**251000**	12245.50	110.66	22.13	**12.55**	100.00
Căscioarele-spring						
L	152400	927.80	30.46	6.09	7.62	59.95
S_1	67800	430.20	20.74	4.15	3.39	26.67
S_2	34000	402.00	20.05	4.01	1.70	13.38
Σ	**254200**	2476.70	49.77	9.95	**12.71**	100.00
summer						
L	140600	2805.30	52.97	10.59	7.03	42.53
S1	132200	8248.70	90.82	18.16	6.61	39.99
S2	57800	468.20	21.64	4.33	2.89	17.48
Σ	**330600**	20433.30	142.95	28.59	**16.53**	100.00
autumn						
L	167600	2138.80	46.25	9.25	8.38	51.32
S_1	103000	549.00	23.43	4.69	5.15	31.54
S_2	56000	723.50	26.90	5.38	2.80	17.15
Σ	**326600**	6270.80	79.19	15.84	**16.33**	100.00

The enchitreids and lumbricides have a more intense participation at Căscioarele in the process of decomposition of the dead vegetal matter. The values of the biodiversity indexes are higher at Căscioarele compared to the ones at Călugăreni site (Tabs. 5; 6).

The biomass accumulated in the process of reproduction evolves according to the same curve as the numerical density.

Tabl. 5 - The structural indices of the enchytreides populations

Călugareni spring	x/m^2	s^2	STDEV	s'	CV	mg/m^2	A%	C%	$p_i \log p$		
Fridericia ratzeli	80	0.7	0.837	0.17	104.58	2.56	40	60	-0.159		
Fridericia bulbosa	40	0.8	0.894	0.18	223.61	1.28	20	20	-0.140		
Fridericia callosa	20	0.2	0.447	0.09	223.61	0.64	10	20	-0.100		
Enchytraeus albidus	40	0.8	0.894	0.18	223.61	1.28	20	20	-0.140		
Achaeta eiseni	20	0.2	0.447	0.09	223.61	0.64	10	20	-0.100	H(S)	2.12
Σ	**200**	8.5	2.915	0.58	145.77	**6.4**	100		-0.639	Hmax	2.32
summer										E%	**91.39**
Fridericia ratzeli	100	1.5	1.225	0.24	122.47	3.2	14.71	60	-0.122		

Fridericia bulbosa	160	2.8	1.673	0.33	104.58	5.12	23.53	60	-0.148		
Fridericia callosa	100	2.0	1.414	0.28	141.42	3.2	14.71	40	-0.122		
Enchytraeus albidus	100	3.0	1.732	0.35	173.21	3.2	14.71	40	-0.122		
Achaeta eiseni	220	7.2	2.683	0.54	121.97	7.04	32.35	60	-0.159	H(S)	2.24
Σ	**680**	55.7	7.463	1.49	109.75	21.76	100		-0.674	Hmax	2.32
autumn										E%	**96.38**
Fridericia ratzeli	140	2.8	1.673	0.33	119.52	4.48	70	60	-0.108		
Fridericia bulbosa	40	0.8	0.894	0.18	223.61	1.28	20	20	-0.140		
Enchytraeus albidus	20	0.2	0.447	0.09	223.61	0.64	10	20	-0.100	H(S)	1.16
Σ	**200**	2.5	1.581	0.32	566.74	**6.4**	100	100	-0.348	Hmax	1.58
										E%	**72.98**
Căscioarele spring											
Fridericia ratzeli	400	27.0	5.196	1.04	129.90	12.8	31	80	-0.158		
Fridericia bulbosa	220	3.7	1.924	0.38	87.43	7.04	17	80	-0.131		
Fridericia callosa	260	1.3	1.140	0.23	43.85	8.32	20	100	-0.141		
Fridericia galba	80	1.7	1.304	0.26	162.98	2.56	6	40	-0.075		
Mesenchytraeus beumeri	180	6.2	2.490	0.50	138.33	5.76	14	60	-0.120		
Enchytraeus albidus	40	0.3	0.548	0.11	136.93	1.28	3	20	-0.047		
Achaeta eiseni	100	3.0	1.732	0.35	173.21	3.2	8	20	-0.087	H(S)	2.52
Σ	**1280**	15.2	3.899	0.78	872.6	40.96	100		-0.759	Hmax	2.81
summer										E%	**89.75**
Fridericia ratzeli	400	9.5	3.082	0.62	77.06	12.8	38	80	-0.160		
Fridericia bulbosa	160	4.8	2.191	0.44	136.93	5.12	15	40	-0.125		
Fridericia callosa	280	9.2	3.033	0.61	108.33	8.96	27	80	-0.153		
Fridericia galba	160	1.3	1.140	0.23	71.26	5.12	15	80	-0.125		
Fridericia leydigi	40	0.8	0.894	0.18	223.61	1.28	4	20	-0.054		
Mesenchytraeus beumeri	160	5.3	2.302	0.46	143.89	5.12	15	40	-0.125	H(S)	2.05
Σ	**1040**	54.8	7.403	1.48	71.18	33.28	100		-0.618	Hmax	2.32
autumn										E%	**88.36**
Fridericia ratzeli	660	41.3	6.427	1.29	97.37	21.12	55	100	-0.143		
Fridericia bulbosa	340	9.3	3.050	0.61	89.69	10.88	28	80	-0.155		
Fridericia galba	20	0.2	0.447	0.09	223.61	0.64	2	20	-0.030		
Enchytraeus albidus	100	0.5	0.707	0.14	70.71	3.2	8	80	-0.090		
Achaeta eiseni	80	1.2	1.095	0.22	136.93	2.56	7	40	-0.078	H(S)	1.65
Σ	**1200**	79.5	8.916	1.78	74.30	38.4	100		-0.496	Hmax	2.32
										E%	**70.96**

Tab. 6 - The structural indices of lumbricides populations

Căscioarele spring	x/m^2	s^2	STDEV	s'	CV	mg/m^2	A%	C%	$p_i \log p_i$		
Aporrectodea rosea	25.6	3.3	1.817	0.18	113.54	0.083	800	60	-0.045		
Lumbricus rubellus	3.2	0.2	0.447	0.09	223.6	0.004	11	20	-0.106	H(S)	1
□	**28.8**	3.2	1.789	0.27	337.14	0.087	811	80	-0.151	Hmax	1
										E%	**50**
summer											
Aporrectodea rosea	12.8	1.7	1.304	0.13	162.98	0.042	133	40	-0.139		
Lumbricus rubellus	9.6	0.8	0.894	0.18	149.1	0.011	43	40	-0.158	H(S)	1
□	**22.4**	3.8	1.949	0.31	312.05	0.052	176	80	-0.297	Hmax	1

										E%	**99**
Călugăreni spring											
Aporrectodea rosea	9.6	0.8	0.894	0.09	149.07	0.031	100	40	0	H(S)	0
Σ	**9.6**	0.8	0.894	0.09	149.1	0.031	100	40	0	Hmax	0
										E%	**0**
summer											
Allolobophora leoni	1.60	0.2	0.447	0.04	447.21	0.002	20	20	-0.140		
Lumbricus rubellus	12.8	3.2	1.789	0.36	223.6	0.014	80	20	-0.078	H(S)	1
Σ	**14.4**	3.0	1.732	0.40	670.82	0.017	100	40	-0.217	Hmax	1
										E%	**72**
autumn											
Aporrectodea rosea	6.4	0.8	0.894	0.09	223.61	0.021	200	20	-0.117		
Lumbricus rubellus	3.2	0.2	0.447	0.09	223.6	0.004	33	20	-0.159	H(S)	1
Σ	**9.6**	0.8	0.894	0.18	447.21	0.024	233	40	-0.276	Hmax	1
										E%	**92**

At Căscioarele, there have been registered 37 species of oribatides with a total of 20600 ind/m^2.

The dominant species are in spring: *Epilohmania cylindrica* (600 ind/m^2) in L; *Steganacarus* sp., *Epidamaeus bituberculatus* and *Scheloribates distinctus* (400 ind/m^2 each) in S_1 and *Eulohmania ribagai* (400 ind/m^2) in S_2; in summer: *Scheloribates distinctus* (1000 ind/m^2 800 ind/m^2) in L and S_1 and *Epidamaeus bituberculatus* (1200 ind/m^2); in autumn: *Lauroppia neerlandica* (1200 ind/m^2), *Scheloribates distinctus* (800 ind/m^2), *Epidamaeus btuberculatus* (600 ind/m^2), *Enyochthonius minutissimus* (600 ind/m^2) in L and in S_1 there is *Ctenobelba pilosella* (400 ind/m^2)

At Călugăreni there have been registered 24 species of oribatides with a total of 18800 ind/m^2 (Tab. 7).

Tab. 7 - The structural indices of oribatida populations

Căscioarele	spring		summer		autumn	
Layer	x/m^2	S	x/m^2	S	x/m^2	S
L	3800	7.36	1800	2.79	5200	9.73
S1	1400	2.78	3000	4.28	1800	3.33
S2	1000	1.89	600	1.34	2000	3.52
Călugăreni						
L	3800	7.41	4600	6.57	2200	3.68
S1	400	0.89	3000	4.57	800	1.78
S2	0		1000	1.89	3000	4.43

The dominant species are in spring: *Scheloribates distinctus* (2400 ind/m) in L; summer *Scheloribates distinctus* (1000 ind/m^2 and 1400 ind/m^2) in L and S_1 and *Epidamaeus bituberculatus* (1400 ind/m^2), *Ceratozetes fusiger* (800 ind/m^2) in L; autumn: *Scheloribates distinctus* (600 ind/m^2; 1000 ind/m^2) in L and S_1 and *Tectocepheus velatus* 600 ind/m^2) in L and *Epidamaeus bituberculatus* (1200 ind/m^2) in S_2

At Căscioarele there has been registered the highest numerical density, compared to Călugăreni site.

The specific diversity, at Căscioarele registered the highest number of species (37), compared to Călugăreni (24 species), due to their optimal conditions of development.

The signaled species are saprophagous, dependant of the degree of detritus decomposition.

In the ecosystem at Căscioarele, there has been registered a total medium density of 13400 ind/m$^{2.}$ (Prostigmata+Mesostigmata).

The maximum values of the numerical density are registered in the autumn season, due to the new litter adding.

In the ecosystem at Călugăreni, there have been registered a total of 13800 ind/m^2 (Prostigmata+ Mesostigmata) (Tab. 8).

The predator acarians were dominant during: in spring *Veigaia nemorensis, Pseudolaelaps doderoi, Zercon fageticola* (with 400 ind/m^2 each) in the litter; in summer *Glycyphagus* sp. (2200 ind/m^2), *Trachytes aegrota* and *Pachyseius humeralis* (with 600 ind/m^2 each) in the litter; in autumn: *Hypoaspis aculeifer, Pachyseius humeralis, Dendrolaelaps* sp. (with 400 ind/m^2 each) in the litter.

The dominant species of acarian predators were: in spring: *Glycyphagus* sp. (600 ind/m^2) in humus layer *Pachyseius humeralis, Pseudolaelaps doderoi* (with 400 ind/m^2 each) and *Trachytes aegrota* (400 ind/m^2) in the soil layer; in summer: *Glycyphagus* sp. (600 ind/m^2), both in litter and humus layer; in autumn: *Glycyphagus* sp., *Pseudocheles* sp. (with 600 ind/m^2 each), in humus layer.

At Călugăreni registered the highest total numerical density of 13800 ind/m^2 compared to the one at Căscioarele with 13400 ind/m^2 due to the optimal conditions offered by this site.

From the specific diversity point of view, the area at Căscioarele registered the highest number of species (23), being followed by the ecosystem at Călugăreni (21 species).

Tab. 8 - The structural indices of Prostigmata + Mesostigmata populations

Căscioarele	spring		summer		autumn	
Layer	x/m^2	STDEV	x/m^2	STDEV	x/m^2	STDEV
L	2200	1.94	4400	3.13	1800	1.45
S1	1000	0.50	1400	0.85	400	0.45
S2	400	0.55	1000	2.23	800	0.45
Călugăreni						
L	2600	2.11	2400	2.11	1600	1.44
S1	1800	2.01	1600	0.95	2600	2.28
S2	400	0.45	400	0.45	400	0.45

The study of the collembolan fauna indicates a relative low specific composition, represented by 15 and 16 species of collembolan respectively, in the areas at Călugăreni and Căscioarele, compared to the data in the literature (Zivadinovic, J. & Cvijovic, M., 1967; Brestovsky, 1970). Among the collembolan determinant species, two are new for the Romanian fauna (*Cryptopygus debilis* (Cassagnau, 1959) and *Isotoma anglicana* Lubbock, 1862. both being signaled in the area at Călugăreni. One species is new for science, *Protaphorura ionescui* Radwanski, Fiera & Weiner, 2006 which is going to be published.

From the total of 25 identified species, *Isotomiella minor* (Schaffer, 1896), *Parisotoma notables* (Schaffer, 1896) and *Folsomia quadrioculata* (Tullberg, 1871) are species with a high ecologic tolerance, dominant in the studied areas.

The average density of collembolan presented the highest values in the area at Căscioarele (21250 ind/m^2) which shows an important action of the collembolan upon the process of litter decomposition.

The vertical distribution follows a cure having the numerical peak in the litter, decreasing towards the deep layers of the soil. The values of the structural indexes in the stone soil indicates a spectrum with a better stability of the collembolan fauna at this level, compared to the layers S_1 and S_2 of the soil (Tab. 9).

Tab. 9 - The structural indices of collembolan fauna

Călugareni-spring	x	x/m^2	s^2	STDEV	CV	mg/m^2
L	2	2000	2.5	1.58	79.05	5.4
S_1	0.4	400	0.3	0.55	136.93	1.08
S_2	0	0	0	0.00	0	0
Σ	2.4	2400	2.3	1.52	63.19	6.48
summer						
L	2	2000	5.5	2.35	117.26	5.4
S_1	0	0	0	0.00	0	0
S_2	0	0	0	0.00	0	0
Σ	2	2000	5.5	2.35	117.26	5.4
autumn						
L	3.4	3400	8.8	2.96	87.24	9.18
S_1	2	2000	2	1.41	70.71	5.4
S_2	1.8	1800	2.7	1.64	91.28	4.86
Σ	7.2	7200	9.7	3.11	43.25	19.44

Căscioarele-spring						
L	3.8	3800	11.7	3.42	90.01	10.26
S_1	0	0	0	0	0	0
S_2	0.2	200	0.2	0.45	223.61	0.54
Σ	4	4000	14.5	3.81	95.20	10.8
summer						
L	0.8	800	0.2	0.45	55.90	2.16
S_1	1	1000	1	1	100	2.7
S_2	1.4	1400	4.3	2.07	148.12	3.78
Σ	3.2	3200	1.7	1.30	40.75	8.64
autumn						
L	5.8	5800	43.7	6.61	113.98	15.66
S_1	3	3000	15.5	3.94	131.23	8.1
S_2	1	1000	2	1.41	141.42	2.7
Σ	9.8	9800	130.7	11.43	116.66	26.46

The list of colembolan species

No	Species	Călugăreni	Căscioarele
1	*Arropalithes principalis*		x
2	*Ceratophysella sylvatica*		x
3	*Ceratophysella* cf. *borealis*		x
4	*Cryptopygus debilis**	x	
5	*Deuteraphorura silvaria*		x
6	*Deuteraphorura* sp. juv.	x	
7	*Folsomia manolachei*		x
8	*Folsomia quadrioculata*	x	x
9	*Folsomides parvulus*	x	
10	*Heteraphorura variotuberculata*	x	
11	*Heteromurus nitidus*		x
12	*Isotoma anglicana**	x	
13	*Isotomiella minor*	x	x
14	*Lepidocyrtus* sp.	x	x
15	*Parisotoma notabilis*	x	x
16	*Protaphorura armata*	x	
17	*Protaphorura ionescui* sp.n. (in press)	x	x
18	*Pseudachorutes subcrassus*		x
19	*Pseudosinella picta*	x	x
20	*Pseudosinella* sp.	x	
21	*Seira domestica*	x	
22	*Stenaphorurella quadrispina*		x
23	*Tomocerus* sp.		x
24	*Tomocerus vulgaris*	x	
25	*Xenylla* sp.		x

*new species for the Romanian fauna

Conclusions

• The pedunculate oak forests in the Romanian Plane remark themselves by the distribution in the herbaceous synusia of some specific elements as *Ruscus aculeatus* (status according in Habitate Directive: rare species) and *Allium ursinum* at Călugăreni and by a consistent tree layer consisting of *Cornus mas* in the ones at Căscioarele forest.

• The anthropic influence suffered in time was concretized at the level of the tree layer by the massive extraction in some areas of *Quercus robor* species and by development in the herbaceous synusia of some nitrophyle elements as *Urtica dioica* and *Parietaria officinalis.*

• The *Quercus* forests, edified from the floral point of view have at the tree layer a high diversity in composition, but in quantity they are dominated by lime tree. The tree density is low due to their age, and the canopy is done by a high range of heights, due to the struggle for light.

• The tree layer is developed, especially in the forest at Căscioarele, where the old trees are higher, canopy, it remarks a more individuals of young trees, but also the young population of young lime tree population is expanding.

• The seasonal dynamics of the herbaceous biomass presents a peak in the spring season at Călugăreni, due to the abundant precipitation.

• In the studied areas, there have been collected 19 species of macromyceta, being remarked a high number of exemplars in the Amanita genus. Among the species met we mention *Lycoperdon perlatum, Amanita vaginata var. grisea, Amanita nivalis, Leccinum crocipodium, Gymnopus fusipes, Schizophyllum commune, Daedalea quercina, Xylarai polymorpha* and species in the genus *Russula* and *Inocybe.*

• The wide specific spectrum and the high number of Thysanoptera specimens at Căscioarele site in the herbaceous layer, indicate optimal conditions of development for these insects.

• The value of diversity index Shannon-Wiener for Thysanoptera is close to the one calculated for the natural mountainous meadow.

• Among the rare coleopteran species, at Căscioarele relevant was *Lucanus cervus* and *Rosalia alpina,* species of European interest – found in the Directive of the European Council, referring to the preservation of natural habitats and to the wild flora and fauna.

• The taxonomical structure of the coleopteran fauna at Căscioarele includes species in the families Chrysomelidae and Coccinellidae which have in general trofic- mezofilous preferences.

• The chilopodes fauna in the litter present a much higher number of individuals in the forest at Căscioarele compared to the one at Călugăreni. The Geophilomorpha order is weakly represented (only 6% of the collected effective), from the order Lithobiomorpa being presented only species belonging to the type *Lithobius*.

• The enchitreides fauna in the Căscioarele site is better represented from specific a numerical point of view, indicating an intense activity of the litter decomposition.

• At Căscioarele there has been recorded the highest numerical density of oribatides.

• The specific diversity of oribatides, at Căscioarele recorded the highest number of species (37) compared to Călugăreni (24 species). The signaled species are saprophagous, dependant of the detritus degree of decomposition, and in terms of numerical densities of species is more advanced at Căscioarele

• At Călugăreni registered at predator acarians the highest total numerical density of 13800 ind/m^2 compared to the one at Căscioarele with 13400 ind/m^2.

• From the specific diversity point of view, at the predator acarians, the site at Căscioarele registered the highest number of species (23) being followed by the ecosystem at Călugăreni (21 species).

• The collembolan fauna indicates a relative low specific composition of 8 and 12 collembolan species in the areas at Călugăreni and Căscioarele, respectively.

• Among the species of collembolan two are new for Romania: *Cryptopygus orientalis* (Stach, 1947), *Isotoma anglicana* (Lubock, 1862), signaled in the area at Călugăreni and one species is new for science, belonging to the *Protaphorura* genus.

• The dominant species, *Isotomiella minor* (Schaffer, 1896) and *Parisotoma notabilis* (Schaffer, 1896) are characteristic to the mesophylous areas.

• The spatial dynamics, the structural indices reveals a richer invertebrate fauna at Căscioarele, while the herbaceous biomass is lower compared with those at Călugăreni.

References

1. BORZA Al., 1963 - *Pflanzengesellschaften der Rumänischen Carpathen*. Biólogia. Casopis Slovenschej Académie Vied. Bratislava, 18, 11: 856-864.
2. BRESTOVSKY J., 1970 - *Synusia of Apterygota of Soil-Fauna of Querco-Carpinetum at bad*, Resp. Project Bad Prog. Rep., Bratislava, 1: 169-175.
3. CÂRȚU D., 1971- *Vegetația lemnoasă dintre Jiu-Desnățui-Craiova şi Dunăre*. Univ. Craiova. Studii şi Cerc.. Subcomisia OMN, filiala Olteniei, Gorj, 2: 213-222.

4. EASON E.H., 1964 - *Centipedes of the British Isles*. F. Warne & Co. Ltd. London.
5. FALCĂ M., LILIANA VASILIU-OROMULU, V. SANDA, MIHAELA PAUCĂ-COMĂNESCU, VIORICA HONCIUC, SANDA MAICAN, DORINA PURICE, ANDREA DOBRE, MINODORA STĂNESCU, MARILENA ONETE, CLAUDIA BIȚĂ-NICOLAE, B. MATEI, I. CODRICI, 2004 - *Ecosystemic characterization of some flooding ash forests from the Neajlov holm (Giurgiu district)*. Proceedings of the Institute of Biology, vol. VI, 59-72.
6. POPESCU A., SANDA V., DOLTU M.I., NEDELCU G.A., 1984 - *Vegetația Câmpiei Munteniei*. Muz. Brukenthal. Studii şi Comunic. Şt. Nat. Sibiu, 26: 173-241; 369-511.
7. RADWAŃSKI J. M., FIERA C., WEINER W. M., 2006 - *A new species of Protaphorura Absolon, 1901 (Collembola: Onychiuridae: Onychiurinae) from Romania and a redescription of Protaphorura glebata (Gisin, 1952)* (in press).
8. SANDA V., POPESCU A., 1971- *Cercetări fitocenologice în pădurile din jurul Bucureştiului*. Studii şi Cerc. de Biol. Seria Bot., 24, 5: 381-390.
9. TUF I.H., 2000 - *Communities of centipedes (Chilopoda) in three floodplain forests of various age in Litovelské Pomoraví (Czech Republic)*.-In: Wytwer, J., Golovatch, S. (eds.): Progress in Studies on Myriapoda and Onychophora. Warszawa, Fragm. faun., 43 (Suppl.): 327-332.
10. ZIVADINOVIC J., CVIJOVIC M., 1967 - *Dynamik der Apterygotenpopulationen in der Waldgesellschaft Querco-Carpinetum Croaticum Hirvat*. [Orig.serbo-kroat.], Godisnjaka Biol. Inst. Univ. Sarajevo, 85-110.

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STRUCTURAL CHARACTERISTICS OF THE BIOCOENOSIS IN THE SESSILE OAK (*QUERCUS PETRAEA*) FOREST FROM SOUTH SUBCARPATHIANS

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ABSTRACT

SANDA V., VASILIU-OROMULU L., PAUCA-COMANESCU M., BARABAS N., FALCA M., HONCIUC V., MAICAN S., STANESCU M., ONETE M., BITA-NICOLAE C., FIERA C., ŞINCU D.E., ION M., 2006 – Structural characteristics of the biocenosis in the sessile oak (*Quercus petraea*) forest from south subcarpathians. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 138-151.

The sessile oak forests in the southern area of Subcarpathians are characterized by the domination of some nemoral elements of the Fagetalia order and even Querco-Fagetea and by the infiltration of some termofilous elements belonging to the *Quercetea pubescenti-petraeae* class which give those phytocoenosis a distinct particularity. The main consumers and decomposers in their spatial and temporal dynamics are presented form larger communities with an active dynamics in the site Cobia, compared to the one at Sărata Monteoru.

Key words: structural characteristics, *Quercus petraea*, south subcarpathians

Introduction

The sessile forests are found in the all hilly areas at 200-600 m altitude, on brown forest soil, medium podzolic, generally.

Among the most important studies of the forests structure we mention: Paşcovschi S. et Doniţă N. (1967), Pop I. (1978), Cristurean I. (1968), Burduja C.et al. (1973), Chifu Th. et al. (1973), Ştefan N. (1981), Mititelu D. et al. (1971; 1986), Popescu A. şi Sanda V. (1992), Popescu Gh. (1975).

Those are valuable contributions of the many thermophilous species prominence in these fitocoenosis. There are performed important comparative analyses of the woody phytocoenosis on the different orientation slopes.

Material and methods

Querco petraeae-Carpinetum Soó et Pocs 1957, the forests of sessile oak with hornbeam cover in the studied territory the plane plateaus but also the medium slope versants at Cobia or strong waved versants at Sărata Monteoru, with southern exposure.

The density and the dendrometric measurements of the trees were determined on circular areas of 500 sq.m; tree diameter was determined with a scaled ruler, their height was determined by direct measurements with the Bitterlich relascope and also by the specific curves of regression. The volume of wood was calculated with the tables of production.

The indices of frequency, density and biomass of the herbaceous species were determined using sampling areas of 50/50 cm, in 10 replicates.

The fauna of invertebrate from the canopy and the herbaceous layer was collected with the entomologic net of 60 ø cm and 30 ø cm in diameter, 10 samples each; the mobile fauna from the soil surface being captured with Barber traps, 9 samples of each; for centipedes using samples 25 /25 cm, 10 samples each; the edaphic fauna of Nematoda, Enchytraeidae, Collembola and Acari was sampled with a MacFadyen probe, 10 samples for each group of organisms; the lumbricides were collected on 10 areas of 25/25 cm.

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Results and discussions

The canopy consistency is of 0.8-0.9, which prevents the development of a more compact tree layer, in both sites. The herbaceous synusia is formed by populations of *Carex pilosa, Lathyrus vernus, Carex sylvatica,* which form in general beds in which many species of ***Fagetalia*** and ***Querco-Fagetea*** are inserted. Thermofilous elements as *Melittis melissophyllum, Tamus communis, Lychnis coronaria, Vincetoxicum hirundinaria, Lithospermum purpurocaerulem, Quercus farnetto* are more present as number of individuals at Sărata Monteoru, compared to the forests at Cobia.

Carpinus betulus population quantitatively dominates the trees layer. Comparatively with *Quercus robur*, *Carpinus betulus* has a greater extension in the lower part of the trees canopy.

The shrubs layer is dominated by scrubs older individuals and also by youngsters of the dominant trees populations (especially hornbeam). It has a reduced density but the existing individuals size secure a smooth transition through the trees layer.

Tab. 1 - Ecological characterization of trees and shrubs layer

Călugăreni		Căscioarele	
Querco robori – Carpinetum Borza 37		*Querco robori – Carpinetum* Borza 37	
Density: 480 ind/ha		Density: 280 ind/ha	
Mature forest, over 100 years		Mature forest, over 100 years	
Species present	Species ratio %	Species present	Species ratio %
Trees		Trees	
Quercus robur	4.2	*Quercus robur*	42.5
Tilia tomentosa	46.8	*Quercus cerris*	36.0
Carpinus betulus	29.0	*Carpinus betulus*	21.5
Acer campestre	16.7		
Acer platanoides	4.2		
Shrubs		Shrubs	
Tilia tomentosa	48	*Ligustrum vulgare*	58
Carpinus betulus	17	*Carpinus betulus*	46
Acer campestre	29	*Cornus mas*	4
Ulmus minor	6		

Tab. 2 - *Querco petraeae-Carpinetum* Soó et Pócs 1957

No. survey	1	2	3	4	5	6	7	8	9	10	11	12	K
Height veget. - trees	16	18	20	20	18	20	16	16	12	14	16	15	
- shrubs	5	6	5	5	6	6	6	5	5	6	6	6	
- herbaceous	40	40	60	60	65	60	30	40	30	45	40	40	
Coverage (%) - trees	80	85	80	85	75	80	80	85	90	85	80	85	
-shrubs	10	8	10	10	10	10	10	15	15	15	15	15	
-herbaceous	80	75	60	60	45	40	15	20	25	15	15	15	
Surface (m^2)	500	500	500	500	500	500	500	500	500	500	500	500	
Car. ass.													
Carpinus betulus	2	3	2	3	2	3	1	+1	+1	1	1	1	V
Quercus petraea	3	2	3	2	3	2	4	4	4	4	4	4	V
Galium schultesii	+	+	+1	+	+	+	+		+	+	+	+	V
Lathyro hallerstenii-Carpinenion													
Carex pilosa		+	+1		+	+		+	+		+	+	IV
Acer campestre	+		+	+		+	+		+		+		III
Campanula trachelium	+		+	+		+		+	+	+		+	IV
Carex digitata		+	+		+			+		+		+	III
Digitalis grandiflora		+		+				+		+		+	III
Lamium maculatum	+		+			+		+		+		+	III
Ligustrum vulgare		+		+			+	+	+	+		+	III
Melampyrum bihariense		+	+		+			+		+		+	III
Symphyto-Fagion													
Actaea spicata			+	+									I
Asarum europaeum			+		+		+		+		+	+	III

Hedera helix		+		+	+		+		+		+	+	IV
Lathyrus venetus	+		+1		+		+		+		+	+	III
Luzula luzuloides	+		+	+		+	+		+		+1	+	IV
Mercurialis perennis							+	+	+1	+	+		III
Moeringio muscosae-Acerenion													
Acer platanoides		+	+		+								II
Fagetalia													
Galium odoratum	+		+		+		+		+		+	+	III
Euphorbia amygdaloides		+		+		+		+				+	III
Lamium galeobdolon		+	+		+		+		+	+	+	+	IV
Lathyrus vernus		+		+			+		+		+	+	III
Carex sylvatica		+		+		+			+		+		III
Campanula rapunculoides		+	+	+	+	+	+	+		+		+	IV
Pulmonaria officinalis	+		+		+		+	+	+		+		III
Fagus sylvatica			+	+								+	II
Scrophularia nodosa			+	+									I
Aegopodium podagraria			+		+								I
Ajuga reptans			+	+			+		+	+		+	III
Allium ursinum		+		+			+		+		+		III
Dentaria bulbifera	+		+		+		+	+		+		+	III
Circaea lutetiana		+		+	+								II
Stachys sylvatica		+	+		+		+	+		+		+	III
Viola reichenbachiana		+		+		+		+		+			III
Mycelis muralis	+		+		+		+		+		+		III
Millium effusum		+	+	+									II
Querco – Fagetea													
Corylus avellana	+	+		+		+		+	+		+	+	IV
Dactylis glomerata	+		+			+	+		+		+	+	III
Cruciata glabra		+		+			+		+			+	III
Crataegus monogyna	+	+		+	+		+		+		+		III
Cornus sanguinea			+		+		+	1-2		+1	1		III
Melica uniflora		+	+	+1		+1	1			+1	+	+	IV
Poa nemoralis		+		+		+			+		+		III
Geum urbanum		+		+		+		+		+		+	III
Brachypodium sylvaticum		+1	+		+		+		+		+		III
Convallaria majalis	+		+										I
Campanula persicifolia	+	+		+		+							II
Tilia tomentosa		+		+		+		+		+	+		III
Cornus mas		+	+		+			+			+		III
Qercetea pubescenti-petreae+ Orno-Cotinetalia													
Melittis melissophyllum							1		+	+			II
Tamus communis							+	+1		+		+	II
Lychnis coronaria								+	+		+		II
Vincetoxicum hirundinaria								+	+		+		II
Lithospermum purpurocaeruleum			+	+			+	+			+		III
Astragalus glycyphyllos		+	+		+		+		+		+		III
Variae Syntaxa													
Bilderdykia convolvulus		+		+		+		+			+		III
Sambucus nigra			+	+			+						II
Urtica dioica	+		+			+			+			+	III
Alliaria petiolata				+	+		+		+	+			III
Veronica chamaedrys			+	+									I

1survey: 4*:* *Galium aparine*, 5: *Asperula taurina*, 8: *Digitalis ferruginea*, 9: *Quercus farnetto*, *Trifolium pratense*, 10: *Arum orientale*, 11: *Silene viridiflora*, 12: *Rubus hirtus*

The places and the date: Sărata Monteoru: 1-2: 17.05.2005, 3-4: 6.07.2005, 5-6: 9.09.2005. Cobia: 7-8: 17.05.2005, 9-10: 6.07.2005, 11-12: 10.09.2005.

The seasonal dynamics of the herbaceous biomass presents a peak during the vernal season in both sites, probably due to the heavy precipitations during this time of the year. The biomass of the herbaceous layer in the forest at Sărata Monteoru presents double values compared to the one in the Cobia forest, the northern exposure having an important role. The presence of a renewal layer for the dominant species *Quercus petraea*, on wide surfaces in Sărata Monteoru forest is characteristic.

During the summer season, the lack of precipitations determines a decrease in the biomass, much more in Sărata Monteoru forest than in Cobia forest, and then, in the autumnal season, in the same time with the amount of precipitations, the biomass increases, also more in Sărata Monteoru forest than in Cobia forest.

The high difference between the biomasses of the two sites can be not only due to the exposure, but also to the slope which is more accentuated in the case of Cobia forest.

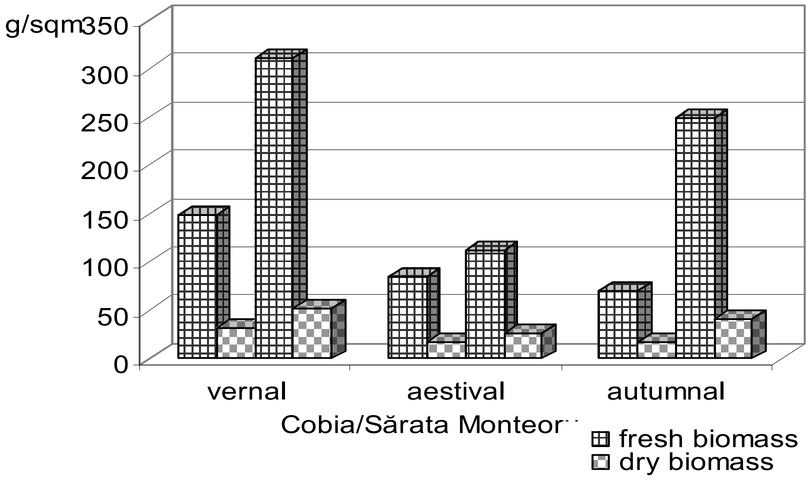

Fig. 1 - The seasonal dynamics of the herbaceous biomass

The specific richness of macromycetes in the studied areas is represented by 28 terricolous and corticolous species. Amond the collected species, are important: *Daldinia concentrica, Xylaria polimorpha, Marasmius rotula, Scleroderma verrucosum, Amanita vaginata* var. *vaginata, Cyathus striatus, Crucibulum laeve, Lactarius piperatus, Trametes versicolor* and species in the genus *Russula* and *Hygrocybe.* A high number of exemplars from *Lactarius piperatus* was been remarked.

The study of the consumers and decomposers is of a higher complexity compared to the one o the primary producers, due to their large ecologic specialization. The high diversity of terrestrial animals is dependant on the type of ecosystem, on the stratification of flora and vegetation.

The vertical structure of the primary secondary consumers in the forest ecosystems determines delimitation, according to compartments of consumers, in: canopy, herbaceous layer and soil fauna.

The invertebrate fauna in the canopy of the sessile oak forests is mainly formed by phytophagous, highly dependant on the substrate, the tree top creating a specific microhabitat.

The zoocoenosis is formed by 9 groups of invertebrates, common to the two sites.

A total of 12 superspecific taxa at Cobia, with a good representation of the ratio phytophagous / zoophagous, prove a strong community with a more equilibrated seasonal dynamics than in the sessile oak forests at Sărata Monteoru.

In the sessile oak forest at Sărata Monteoru the coenosis is formed by 11 groups of invertebrates; there are isolated appearances of centipedes, ortopterans, odonates; the temporary dynamics of dipterans indicate a weak balanced coenosis, with an obvious antropic impact.

The values of the numerical abundance of the invertebrate fauna in canopy of the sessile oak forests are higher at Cobia, 1.87 times in spring, 1.71 times in summer, 1.67 times in autumn, compared to Sărata Monteoru.

So, at Cobia the association of invertebrates is dynamic, with a positive evolution and without a mass reproduction of the pests, due to the compact structure of the canopy.

At Sărata Monteoru the northern exposure of the site, the massive extraction of trees, so the anthropic impact also reflects themselves in the composition of invertebrate associations from the canopy.

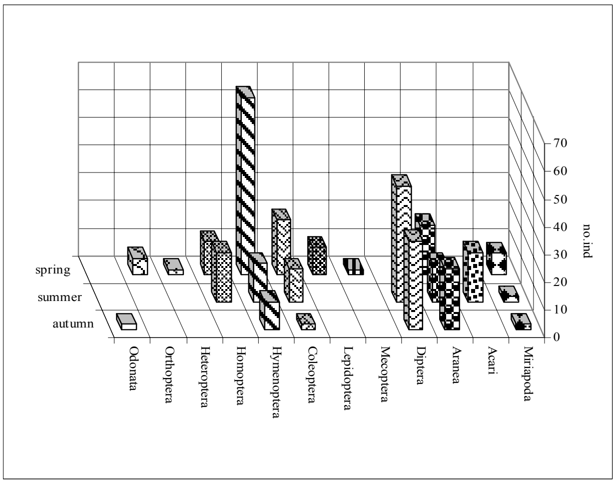

Fig. 2 - Numerical abundance of invertebrate fauna from the canopy – Cobia

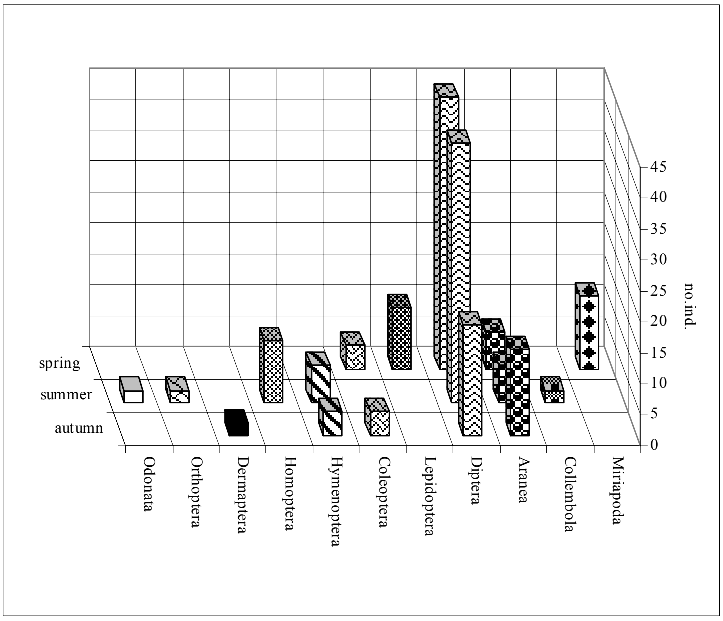

Fig. 3 - Numerical abundance of invertebrate fauna from the canopy – Sărata Monteoru

In the herbaceous layer of the sessile oak forests, the primary, secondary, and third consumers transfer, from a link of the trophic chain to the other, the matter and energy, contributing to the ecosystem equilibrate.

The majority of invertebrates in the herbaceous layer are phytophagous; the relationship between producers and consumers is based on the principle of optimization, from which derives the profitability of the ecosystem.

In both sessile oak forests, 14 superspecific taxa among the invertebrates form the zoocoenosis of the herbaceous layer, the significant differences being at the level of their numerical components.

Thus, at Cobia, a total density of 513 ind/m^2, presented a curve of the seasonal dynamics with a peak displaced in summer (435 ind/m^2) compared t the total density of the zoocoenosis at Sărata Monteoru with only 385 ex/m^2 and with a numerical peak at spring, of 25 ind/m^2.

The southern exposure of Cobia site, the presence of some Mediterranean plants like *Tamus communis* and the rough relief with a slope of over 25% and northern exposure of the sessile oak forest at Sărata Monteoru can be the causes of the notable differences between the two sessile oak forests.

In the temporal dynamics, at Cobia, the majority of superspecific taxa are well represented in every season, while at Sărata Monteoru only during spring (Figs. 4; 5).

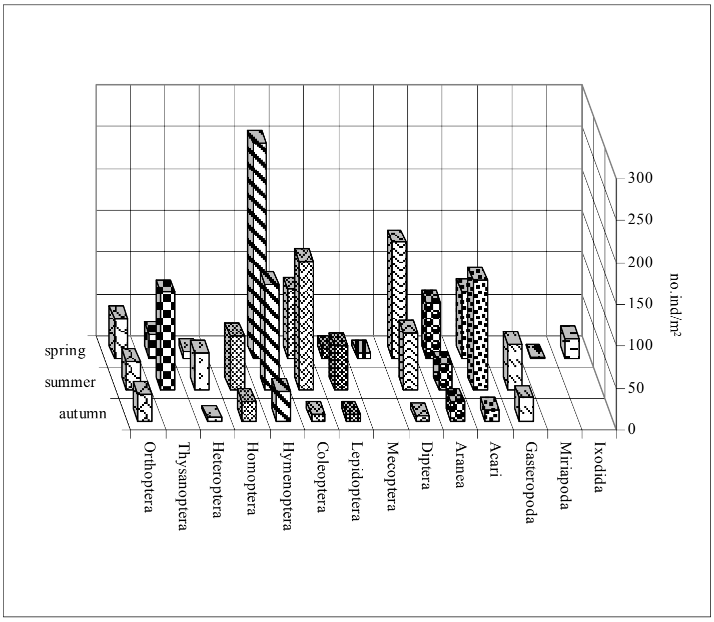

Fig. 4 - Numerical density of invertebrate fauna from the herbaceous layer –Cobia

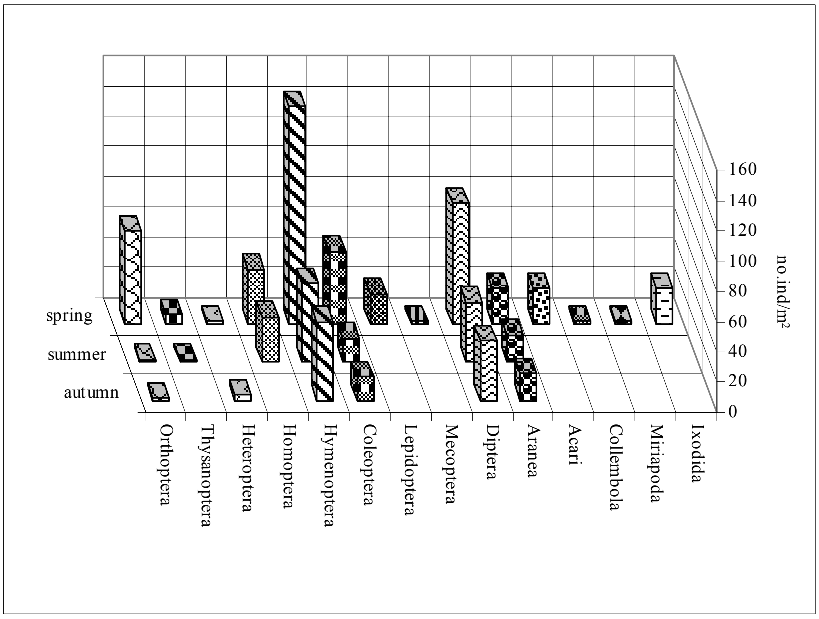

Fig. 5 - Numerical density of invertebrate fauna from the herbaceous layer – Sărata Monteoru

The biologic characteristic indicators of the herbaceous layer, thrips (Insect: Thysanoptera) are structured in a strong community, rich at Cobia, with a maximum numerical peak in the seasonal dynamics at summer. During spring, the skiophylous species *Taeniothrips picipes* with a high number of larvae indicated a high development of the population.

During the summer time, the number of species is richer, dominated by the praticolous species *Frankliniella intosa*. The numerical density of thrips population is of 116 indx/m^2, which means a biomass incorporation of 64.0 mg.f.w/m^2 (Table 3). Functional index, the energetically metabolism presents high values of 1.60 ml.O_2/m^2 indicating a high activity.

The Shannon-Wiener diversity index had a high value, of 2.59 corresponding to an equitability of 82.0%.

At Sărata Monteoru, the presence and the numerical density of trips is very low (Table 3) indicating an unbalanced coenosis of the herbaceous layer, with no positive evolution.

Tab. 3 - The structural and functional indices of the Thysanoptera populations (sweepings)

Cobia spring	-x/m^2	s^2	STDEV	s'	CV	mg.f.w /m^2	mg.d.w /m^2	energ.metab. ml O_2/m^2	A%	C%	p_i log p_i
Taeniothrips picipes	2	0.2	0.4	0.09	224	1.60	0.20	0.04	7	20	-0.082
Thrips larve	22	24.2	4.9	0.98	224	17.60	2.20	0.44	79	20	-0.082
Haplothrips niger	4	0.8	0.9	0.18	224	3.20	0.40	0.08	14	20	-0.121
Σ	**28**	32.7	5.7	1.14	204	**22.40**	**2,80**	**0.56**	100		-0.285
		H(S)	**0.95**		**H_{max}**	**1.58**	**E%**	**60**			
summer											
Anaphothrips atroapterus	4	0.8	0.9	0.18	224	3.20	0.40	0.08	3.45	20	-0.050
Aptinothrips rufus	8	3.2	1.8	0.36	224	6.40	0.80	0.16	6.90	20	-0.080
Aptinothrips stylifer	6	1.8	1.3	0.27	224	4,80	0.60	0.12	5.17	20	-0.067
Chirothrips manicatus	8	3.2	1.8	0.36	224	6.40	0.80	0.16	6.90	20	-0.080
Chirothrips ruptipennis	10	5.0	2.2	0.45	224	8.00	1.00	0.20	8.62	20	-0.092
Frankliniella intonsa	46	20.8	4.6	0.91	99	36,80	4.60	0.92	39.66	60	-0.159
Limothrips schmutzi	2	0.2	0.4	0.09	224	1.60	0.20	0.04	1.72	20	-0.030
Sericothrips staphylinus	24	15.3	3.9	0.78	163	19.20	2.40	0.48	20.69	40	-0.142
Thrips tabaci	8	3.2	1.8	0.36	224	6.40	0.80	0.16	6.90	20	-0.080
Σ	**116**	118.3	10.9	2.18	94	**64.00**	**8.00**	**1.60**	100		-0.780
		H(S)	**2.59**		**H_{max}**	**3.17**	**E%**	**82**			
Sărata Monteoru spring											
Odontothrips confusus	4	0.8	0.9	0.18	224	3.20	0.40	0.08	66.67	20	-0.117
Haplothrips leucanthemi	2	0.2	0.4	0.09	224	1.60	0.20	0.04	33.33	20	-0.159
Σ	**6**	1.8	1.3	0.27	224	**4,80**	**0.60**	**0.12**	100		-0.276
		H(S)	**0.92**		**H_{max}**	**1**		**E%**	**92**		
summer											
Anaphothrips validus	2	0.2	0.4	0.09	224	1.60	0.20	0.04	100	20	0
Σ	**2**	0.2	0.4	0.09	224	**1.60**	**0.20**	**0.04**	100		0
		H(S)	**0**		**H_{max}**	**0**	**E%**	**0**			

The taxon analysis of the coleopteran fauna in the sessile oak forests at Cobia, indicates a high biodiversity within Coleoptera order, being present species belonging to the **Chrysomelidae, Staphylinidae, Cerambycidae, Buprestidae, Coccinellidae Cantharidae** and **Curculioidae** families.

In the biotop represented by the mesophilous meadow with *Agrostis tenuis* at the edge of the forest, there have been identified the following species: *Labidostomis longimana, Smaragdina saicina, Smaragdina xanthaspis, Clytra laeviuscula, Cryptocephalus moraei, Cryptocephalus flavipes, Cryptocephalus octacosmus, Cryptocephalus bipunctatus, Cryptocephalus sericeus, Cryptocephalus hypochoeridis, Pachybrachis sinuatus, Pales ulema* (typical thermofile element), *Gonioctena fornicata, Calomicrus circumfusus* (**Chrysomelidae**), *Acmaeops collaris, Leptura rufipes, Cortodera humeralis, Judolia cerambyciformis, Chlorophorus varius, Dorcadion fulvum, Rhagium sycophanta* (**Cerambycidae**), *Acmaeodera flavofasciata* (**Buprestidae**), *Cantharis livida ab. Rufipes* (**Cantharidae**), *Calvia quatuordecimguttata, Subcoccinella vigintiquatuorpunctata, Thea vigintiduopunctata, Coccinella septempunctata, Vibidia duodecimguttata* and *Propylaea quatuordecimpunctata* (**Coccinellidae**)

The species *Morimus funereus* Mulsant (an exemplar collected from the forest, leg. D. Şincu) grows in beech and oak, but occasional appearances have been signaled also in the coniferous forests and steps with Poaceae; Status according to IUCN: species with low risk, threatened (LR)

Coleopteran fauna in the sessile oak forests at Sărata Monteoru has been very weak represented, being identified species of chrisomelides (*Gastrophysa polygoni* and *Chtysolina varians*), silfides (*Xilodrepa quadripunctata*), cerambicides

(*Judolia cermbyciformis*) and coccinelides (*Halyzia sedecimguttata*).

Chilopodes can be met mainly in the forest ecosystems. They are nocturnal, hygrophylous towards mesohygrophylous species, which explains the difficulty of bearing conditions different from the ones in the green layer (Minelli A., Golovath S., 2001).

The seasonal variation of the number of individuals was different in the two collecting sites. If at Cobia a high number of individuals have been registered in August, at Sărata Monteoru the number of individuals collected in autumn, decreased.

In the site at Sărata Monteoru, besides species in *Lithobius* genus, some geophylous species and also rare cryptosides with the species *Cryptops anomalans* (Newport, 1844) were present. At Cobia only species belonging to the order *Lithobius* were found.

The nematodes, component of the fauna of soil decomposers, present higher values at Cobia, compared to Sărata Monteoru where the rough relief the slope of 25% have a negative influence upon the density of these organisms group. The relative abundance of these worms in the litter were maximum, and ranged between 34.71% (summer) and 65.50% (autumn) at Cobia.

More homogeneous is the nematodes distribution along the horizontal of the layers at Sărata Monteoru (Tab. 4)

Tab. 4 - The structural indices of nematodes fauna

Călugăreni spring	x/m^2	s^2	STDEV	s'	mg/m^2	A%
L	173600	5226.80	72.30	14.46	8.68	52.57
S_1	104400	1356.80	36.83	7.37	5.22	31.62
S_2	52200	682.70	26.13	5.23	2.61	15.81
Σ	**330200**	15797.70	125.69	25.14	**16.51**	100.00
summer						
L	42200	855.70	29.25	5.85	2.11	32.97
S_1	47800	334.70	18.29	3.66	2.39	37.34
S_2	38000	223.50	14.95	2.99	1.90	29.69
Σ	**128000**	2309.00	48.05	9.61	**6.4**	100.00
autumn						
L	146800	3214.70	56.70	11.34	7.34	58.49
S_1	73800	1215.70	34.87	6.97	3.69	29.40
S_2	30400	670.30	25.89	5.18	1.52	12.11
Σ	**251000**	12245.50	110.66	22.13	**12.55**	100.00
Căscioarele spring	x/m^2	s^2	s	s'	mg/m^2	A%
L	152400	927.80	30.46	6.09	7.62	59.95
S_1	67800	430.20	20.74	4.15	3.39	26.67
S_2	34000	402.00	20.05	4.01	1.70	13.38
Σ	**254200**	2476.70	49.77	9.95	**12.71**	100.00
summer						
L	140600	2805.30	52.97	10.59	7.03	42.53
S_1	132200	8248.70	90.82	18.16	6.61	39.99
S_2	57800	468.20	21.64	4.33	2.89	17.48
Σ	**330600**	20433.30	142.95	28.59	**16.53**	100.00
autumn						
L	167600	2138.80	46.25	9.25	8.38	51.32
S_1	103000	549.00	23.43	4.69	5.15	31.54
S_2	56000	723.50	26.90	5.38	2.80	17.15
Σ	**326600**	6270.80	79.19	15.84	**16.33**	100.00

In the spatial dynamics, the populations of echitreides are dominant at Cobia, where the pedoedafic conditions are optimal; the site has a southern exposure, without slope, and the rich canopy ensure a rich litter.

In the temporal dynamics, the peak of the numerical and biomass density is characteristic to the spring time.

The enchitreides populations had values of the Shannon-Wiener diversity which vary function of the season between 2.05-1.53 and the equitability between 88.39% - 96.50% (Table 5).

The dominant species with high constancy values is *Fridericia ratzeli*, at Cobia, but also at Sărata Monteoru, an ubiquist species with high ecological characteristics.

Tab. 5 - The structural indices of the enchytreides populations

Călugareni spring	x/m^2	s^2	STDEV	s'	CV	mg/m^2	A%	C%	$p_i \log p_i$		
Fridericia ratzeli	80	0.7	0.837	0.17	104.58	2.56	40	60	-0.159		
Fridericia bulbosa	40	0.8	0.894	0.18	223.61	1.28	20	20	-0.140		
Fridericia callosa	20	0.2	0.447	0.09	223.61	0.64	10	20	-0.100		
Enchytraeus albidus	40	0.8	0.894	0.18	223.61	1.28	20	20	-0.140		
Achaeta eiseni	20	0.2	0.447	0.09	223.61	0.64	10	20	-0.100	H(S)	2.12
Σ	**200**	8.5	2.915	0.58	145.77	**6.4**	100		-0.639	Hmax	2.32
summer										E%	**91.39**
Fridericia ratzeli	100	1.5	1.225	0.24	122.47	3.2	14.71	60	-0.122		
Fridericia bulbosa	160	2.8	1.673	0.33	104.58	5.12	23.53	60	-0.148		
Fridericia callosa	100	2.0	1.414	0.28	141.42	3.2	14.71	40	-0.122		
Enchytraeus albidus	100	3.0	1.732	0.35	173.21	3.2	14.71	40	-0.122		
Achaeta eiseni	220	7.2	2.683	0.54	121.97	7.04	32.35	60	-0.159	H(S)	2.24
Σ	**680**	55.7	7.463	1.49	109.75	21.76	100		-0.674	Hmax	2.32
autumn										E%	**96.38**
Fridericia ratzeli	140	2.8	1.673	0.33	119.52	4.48	70	60	-0.108		
Fridericia bulbosa	40	0.8	0.894	0.18	223.61	1.28	20	20	-0.140		
Enchytraeus albidus	20	0.2	0.447	0.09	223.61	0.64	10	20	-0.100	H(S)	1.16
Σ	**200**	2.5	1.581	0.32	566.74	**6.4**	100	100	-0.348	Hmax	1.58
										E%	**72.98**
Căscioarele spring											
Fridericia ratzeli	400	27.0	5.196	1.04	129.90	12.8	31	80	-0.158		
Fridericia bulbosa	220	3.7	1.924	0.38	87.43	7.04	17	80	-0.131		
Fridericia callosa	260	1.3	1.140	0.23	43.85	8.32	20	100	-0.141		
Fridericia galba	80	1.7	1.304	0.26	162.98	2.56	6	40	-0.075		
Mesenchytraeus beumeri	180	6.2	2.490	0.50	138.33	5.76	14	60	-0.120		
Enchytraeus albidus	40	0.3	0.548	0.11	136.93	1.28	3	20	-0.047		
Achaeta eiseni	100	3.0	1.732	0.35	173.21	3.2	8	20	-0.087	H(S)	2.52
Σ	**1280**	15.2	3.899	0.78	872.6	40.96	100		-0.759	Hmax	2.81
summer										E%	**89.75**
Fridericia ratzeli	400	9.5	3.082	0.62	77.06	12.8	38	80	-0.160		
Fridericia bulbosa	160	4.8	2.191	0.44	136.93	5.12	15	40	-0.125		
Fridericia callosa	280	9.2	3.033	0.61	108.33	8.96	27	80	-0.153		
Fridericia galba	160	1.3	1.140	0.23	71.26	5.12	15	80	-0.125		
Fridericia leydigi	40	0.8	0.894	0.18	223.61	1.28	4	20	-0.054		
Mesenchytraeus beumeri	160	5.3	2.302	0.46	143.89	5.12	15	40	-0.125	H(S)	2.05
Σ	**1040**	54.8	7.403	1.48	71.18	33.28	100		-0.618	Hmax	2.32
										E%	**88.36**
autumn											
Fridericia ratzeli	660	41.3	6.427	1.29	97.37	21.12	55	100	-0.143		
Fridericia bulbosa	340	9.3	3.050	0.61	89.69	10.88	28	80	-0.155		
Fridericia galba	20	0.2	0.447	0.09	223.61	0.64	2	20	-0.030		
Enchytraeus albidus	100	0.5	0.707	0.14	70.71	3.2	8	80	-0.090		
Achaeta eiseni	80	1.2	1.095	0.22	136.93	2.56	7	40	-0.078	H(S)	1.65
Σ	**1200**	79.5	8.916	1.78	74.30	38.4	100		-0.496	Hmax	2.32
										E%	**70.96**

The lumbricides, dominant as biomass within the invertebrates in the soil in the two sessile oak forests had a higher numerical density at Cobia and the temporal dynamics during spring, compared to the forest at Sărata Monteoru, where the numerical peak displaced towards autumn, probably due to the richness of new litter and to abundant precipitations.

The Shannon-Wiener diversity presented low values between 1.0 - 1.79, with a variable equitability of 72.0%-100% (Table 6)

Tab. 6 - The structural indices of lumbricides populations

Căscioarele spring	x/m^2	s^2	STDEV	s'	CV	mg/m^2	A%	C%	$p_i \log p_i$		
Aporrectodea rosea	25.6	3.3	1.817	0.18	113.54	0.083	800	60	-0.045		
Lumbricus rubellus	3.2	0.2	0.447	0.09	223.6	0.004	11	20	-0.106	H(S)	1
Σ	**28.8**	3.2	1.789	0.27	337.14	0.087	811	80	-0.151	Hmax	1
										E%	**50**
summer											
Aporrectodea rosea	12.8	1.7	1.304	0.13	162.98	0.042	133	40	-0.139		
Lumbricus rubellus	9.6	0.8	0.894	0.18	149.1	0.011	43	40	-0.158	H(S)	1
Σ	**22.4**	3.8	1.949	0.31	312.05	0.052	176	80	-0.297	Hmax	1
										E%	**99**
Călugăreni spring											
Aporrectodea rosea	9.6	0.8	0.894	0.09	149.07	0.031	100	40	0	H(S)	0
Σ	**9.6**	0.8	0.894	0.09	149.1	0.031	100	40	0	Hmax	0
										E%	**0**
summer											
Allolobophora leoni	1.60	0.2	0.447	0.04	447.21	0.002	20	20	-0.140		
Lumbricus rubellus	12.8	3.2	1.789	0.36	223.6	0.014	80	20	-0.078	H(S)	1
Σ	**14.4**	3.0	1.732	0.40	670.82	0.017	100	40	-0.217	Hmax	1
										E%	**72**
autumn											
Aporrectodea rosea	6.4	0.8	0.894	0.09	223.61	0.021	200	20	-0.117		
Lumbricus rubellus	3.2	0.2	0.447	0.09	223.6	0.004	33	20	-0.159	H(S)	1
Σ	**9.6**	0.8	0.894	0.18	447.21	0.024	233	40	-0.276	Hmax	1
										E%	**92**

In Cobia ecosystem there have been registered 31 species of oribatides (Acari), with a total average density of 8000 ind/m^2.

The dominant species were: in summer *Scheloribates distinctus* (400 ind/m^2); in autumn *Chamobates cuspidatus* (800 ind/m^2), *Protoribates lophothricus* (400 ind/m^2) in L; *Scheloribates fimbriatus* (800 ind/m^2) in S_1 and *Epidamaeus bituberculatus* (400 ind/m^2) in S_2.

At Sărata Monteoru ecosystem there have been registered 15 species of oribatides, with a total average density of 10200 ind/m^2 (Table 7).

Tab. 7 - The structural indices of oribatides populations

Cobia	spring		summer		autumn	
Layer	x/m^2	S	x/m^2	S	x/m^2	S
L	1000	2.24	1800	4.02	1400	2.18
S_1	400	0.89	400	0.89	1400	2.18
S_2	200	0.45	200	0.45	1200	2.68
Sărata Monteoru						
L	1400	2.68	3000	6.36	200	0.45
S_1	600	1.34	1400	1.89	200	0.45
S_2	0	0	400	0.55	3000	5.29

The dominant species in this site were: in spring *Phthiracarus sp.* (600 ind/m^2) in L; *Scheloribates distinctus* (400 ind/m^2) in S_1; in summer: *Lauroppia neerlandica* (1000 ind/m^2), *Medioppia obsoleta* (600 ind/m^2) in L and *Epidamaeus bituberculatus* (100 ind/m^2); in autumn:

Epidamaeus bituberculatus (1600 ind/m^2) and *Scheloribates distinctus* (800 ind/m^2).

The highest numerical density has been recorded in Sărata Monteoru.

From the specific diversity point of view, the site Cobia registered the highest number of species (37) compared to the other site Sărata Monteoru (15 species).

All the species identified are detritophagous, depending on the degree of detritus decomposition.

The order Prostigmata (Acari) had a cosmopolitan and almost unlimited distribution. The species from this order belong to the following families: Pseudocheidae, Glycyphagidae, Trombididae and Anystidae. All these families are represented by zoophagous, microphytophagous and omnivorous species.

Generally, the species from the order Mesostigmata live in the soil and strongly depend on its structure, of the detritus and humus contents, and also on the water in the soil. In the terrestrial ecosystem these categories of species are among the third and secondary consumers, transforming and transferring the primary (vegetal rests) or secondary (other invertebrates) organic substance.

In the ecosystem at Cobia, there have been registered a total of 11600 ind/m^2 (Prostigmata + Mesostigmata).

The dominant species of predator acarians were: in spring *Pergamasus barbarus* (600 ind/m^2) in L; in summer: *Glycyphagus sp.* (1000 ind/m^2), *Prozercon kochi* (600 ind/m^2), *Veigaia nemorensis* (400 ind/m^2) in L; in autumn: *Pseudocheles sp.* (600 ind/m^2) in L, and *Hypoaspis aculeifer* (600 ind/m^2) in humus layer.

In the ecosystem at Sărata Monteoru, there has been registered a number of 13000 ind/m^2 (Prostigmata +Mesostigmata) (Tab. 8).

Tab. 8 - The structural indices of Prostigmata + Mesostigmata populations

Cobia	spring		summer		autumn	
Layer	x/m^2	S	x/m^2	S	x/m^2	S
L	1200	0.45	3600	2.15	2600	2.15
S_1			1800	1.5	1400	2.1
S_2			800	0.8	200	0.4
Sărata Monteoru						
L	1400	1.4	4400	4.25	200	0.45
S_1	400	0.45	3000	2.15	400	0.45
S_2	200	0.45	2600	1.94	400	0.45

The dominat species of predator acarians were: in spring: *Glycyphagus sp.* (400 ind/m^2) in the litter; in summer: *Glycyphagus sp.* (2400 ind/m^2) in soil layer, *Prozercon fimbriatus* (600 ind/m^2), in litter; in autumn: *Veigaia nemorensis* (200 ind/m^2) in soil layer.

The site Sărata Monteoru registered the highest total numerical density of 13.000 ind/m^2, compared to the one at Cobia with 11600 ind/m^2.

From the specific diversity point of view, the area at Cobia registered the highest number of species (20) being followed by the ecosystem at Sărata Monteoru (17 species).

All the identified species are in general predator species, strongly depending on the other groups of invertebrates, which represent their source of food.

The coenosis at collembolan was formed by 19 species, 10 in the area at Sărata Monteoru and 9 in the area at Cobia.

Among the identified collembolans species, three are new for the Romanian fauna: *Neamura minuta* (Gisin 1963) and *Deutomura albella* (Stach, 1920), *Protaphorura serbica* (Loska & Bogojevic, 1967), the fist two being signalled in pieces of decomposed trunk of a *Quercus* species.

Parisotoma notabilis (Schaffer, 1896) and *Folsomia quadrioculata* (Tullberg, 1871) are dominant species, with a high ecologic tolerance.

The average density of collembolans presented the highest values in the area at Cobia (9750 ind/m^2). In both areas, we remark the preference of collembolans fauna for green layer, where the highest values of numerical densities and biomass index have been registered (Tab. 9).

The constant modifications in the collembolans community structure in the soil reflect functional changes of forest ecosystems, with direct consequences upon the biodegradation of the vegetal rests.

The minimum value of the numerical density was registered during summer, in the sessile forests area at Sărata Monteoru, due to the dry conditions during summer.

The collembolan species are more sensitive than acarians to the structural and functional changes of the ecosystems. The communities of collembolan are influenced by the quantity and quality of the herbaceous layer, but other factors (humidity, soil pH, temperature) can be responsible for the spatial and temporal distribution and for the numerical density.

Tab. 9 - The structural indices of collembolan fauna

Cobia- spring	**x**	**x/m²**	**s²**	**s**	**CV**	**mg/m²**
L	0.2	200	0.2	0.45	223.61	0.54
S_1	0.2	200	0.2	0.45	223.61	0.54
S_2	0.2	200	0.2	0.45	223.61	0.54
Σ	0.6	600	0.3	0.55	91.29	1.62
summer						
L	1.2	1200	1.2	1.10	91.29	3.24
S_1	0.6	600	0.8	0.89	149.07	1.62
S_2	0.2	200	0.2	0.45	223.61	0.54
Σ	2	2000	2	1.41	70.71	5.4
autumn						
L	3.6	3600	28,8	5.37	149.07	9.72
S_1	1.2	1200	1.7	1.30	108.65	3.24
S_2	0.4	400	0.8	0.89	223.61	1.08
Σ	5.2	5200	24.7	4.97	95.58	14.04
Sărata Monteoru						
spring						
L	1	1000	1	1	100	2.7
S1	0.4	400	0.3	0.55	136.93	1.08
S2	0.6	600	0.3	0.55	91.29	1.62
Σ	2	2000	2.5	1.58	79.06	5.4
summer						
L	0.8	0.0008	1.7	1.30	162.98	0.000002
S1	0	0	0	0	0	0
S2	0	0	0	0	0	0
Σ	0.8	0.0008	1.7	1.30	162.98	0.000002
autumn						
L	1	1000	1.5	1.22	122.47	2.7
S1	0.2	200	0.2	0.45	223.61	0.54
S2	0	0	0	0	0	0
Σ	1.2	1200	1.7	1.30	108.65	3.24

The list of collembolan species

No.	**Species**	**Sărata-Monteoru**	**Cobia**
1	*Deutonura albella**	x	
2	*Folsomia manolachei*		x
3	*Folsomia quadrioculata*		x
4	*Isotomiella minor*	x	
5	*Lepidocyrtus* sp.		x
6	*Neanura minuta**	x	
7	*Oncopodura crassicornis*	x	
8	*Orchesella* sp.	x	
9	*Onychiuroides granulosus*		x
10	*Parisotoma notabilis*		x
11	*Pogonognathellus flavescens*		x
12	*Protaphorura serbica**		x
13	*Protaphorura ionescui* sp.n. (in press)		x
14	*Pseudachorudina palmiensis*	x	
15	*Pseudachorutes* sp.	x	
16	*Pseudosinella* sp1	x	
17	*Pseudosinella* sp.2		x
18	*Thaumanura carolii*	x	
19	*Tomocerus* sp.	x	

*new species for Romanian fauna

Conclusions

- The sessile oak forests are distributed on the south chain of the Subcarpathians, occupying the versants with sunny exposures, which allowed the development in the herbaceous layer, among many species of *Fagetalia,* of some thermophylous elements like *Lychnis coronaria, Tamnus communis, Melittis melysophyllum,* etc.
- In the phytocoenosis at Sărata Monteoru, recent massive extractions seem to be compensated by a strong regeneration from many young trees that are now in these forests.
- The tree layer is dominated by oak which extends to the inferior side from the canopy in comparison to the sessile oak.
- The tree layer is dominated by old trees, but also by young populations of the dominant trees (especially oak). It has a lower density, and the dimensions of the existent exemplars ensure a smooth pass to the structure of tree layer.
- The seasonal dynamics of the biomass presents a descendant curve during summer, common to the two areas, the values of the biomass being dominant at Sărata Monteoru.
- The specific richness of macromycetes in the studied area is represented by 28 species, both terricolous and corticoloues. Among the collected species we mention: *Daldinia concentrica, Xylaria polimorpha, Marasmius rotula, Scleroderma verruncosum, Amanita vaginata* var. *vaginata, Cyathus striatus, Crucibulum laeve, Lactarius piperatus, Trametes versicolor,* and species from the genus *Russula* and *Hygrocybe*. A high number of exemplars of *Lactarius piperatus* were remarked.
- Important bioindicators of the zoocoenosis in the herbaceous layer, Thysanoptera are represented by a high number of species at Cobia. The dominant ones are *Frankliniella intonsa, Sercothrips staphylinus* and *Chirothrips ruptipennis.*
- The high values of the numerical density/m^2 at Cobia, and also the numerous larva of Thripidae proves an active dynamics of this fauna.
- The taxonomic analysis of the coleopteran fauna in the sessile oak forests at Cobia indicate a high biodiversity within the Coleoptera order, by presence of some species belonging to the families Chrysomelidae, Staphylinidae, Cerambycidae, Buprestidae, Coccinellidae and Cantharidae.
- Coleopteran fauna in the sessile oak forests of *Querco petraeae- Carpinetum* at Sărata Monteoru was very weak represented, being evidentiated species of crisomelides (*Gastrophysa* and *Chrysolina varians*), sulfides (*Xilodrepa quadripunctata*), cerambicides (*Judolia cerambyciformis*) and coccinelides (*Halyzia sedecimguttata).*
- In the soil the seasonal variation of the number of individuals of chilopodes was different in the two collecting sites. If at Cobia the highest number of individuals has been registered in August, at Sărata Monteoru the number of individuals that have been captured this year decreased.
- In terms of spatial dynamics, the enchitreides fauna is dominant in Cobia site, where the numerical density/m^2 is maximal during the spring season.
- The highest density of oribatides has been registered at Sărata Monteoru.
- From the specific diversity point of view, the area at Cobia presents the highest number of species (37) compared to the area at Sărata Monteoru (15 species).
- All the identified species are detritophagous, depending on the degree of decomposition of detritus.
- Compared to the numerical density of species, the decomposition is more advanced at Sărata Monteoru.
- The site Sărata Monteoru presented the highest total numerical density for predator acarians (Prostigmata + Mesostigmata) of 13000 ind/m^2 compared to the one at Cobia with 11600 ind/m^2.
- From the specific diversity point of view, the area at Cobia registered the highest number of species (20) followed by the ecosystem at Sărata Monteoru (17 species).
- The colembolans present a very low specific compostion, represented by 7 and 7 species in the areas at Sărata Monteoru and Cobia, respectively.
- Among the identified species of collembolans, three are new for Romania fauna *Neamura minuta* (Gisin 1963) and *Deutomura albella* (Stach, 1920), both of them being identified in the area at Sărata Monteoru in pieces of decomposed log and *Protaphorura serbica* (Loska & Bogojevic, 1967).
- The invertebrate fauna from the canopy, herbaceous layer and from the soil reveals a dynamics coenosis at Cobia and a reduced one at Sărata Monteoru, due to the anthropic impact.

References

1. BRESTOVSKY J., 1970 - *Synusia of Apterygota of Soil-Fauna of Querco-Carpinetum at bad, Resp*. Project Bad Prog. Rep., Bratislava, 1: 169-175.
2. BURDUJA C., MIHAI GH., SÂRBU I., 1973 - *Flora şi vegetaţia masivului Mărgineni (jud. Neamţ)*. Lucr. Staţ. Stejarul Pângăraţi. Ecologie terestră şi genetică, 1972-1973, 53-63.
3. CRISTUREAN I., 1968 - *Aspecte de vegetaţie din tăieturile de păduri de gorun de pe dealul Hederiş (Bistriţa-Năsăud).* Analele Univ. Buc. Seria Şt. Nat. Biol. XVII: 203-212.

4. FALCĂ M., VASILIU-OROMULU L., POPESCU A., SANDA V., PAUCĂ-COMĂNESCU M., HONCIUC V., MAICAN S., PURICE D., STĂNESCU M., ONETE M., BIȚĂ-NICOLAE C., MATEI B., 2003 - *The ecosystemic study of some thermophilous Quercus-forests from the Romanian plain*. Proceedings of the Institute of Biology, vol. V. 47-60.
5. MINELLI A., GOLOVATCH S.I., 2000 - *Myriapods*. – In: Levin, S.A. (Ed.): Encyclopedia of Biodiversity. Academic Press, San Diego, 4: 291-303.
6. MITITELU D., RUGINĂ R., ŞTEFAN N., 1986 - *Vegetația de pe Măgura Odobeşti, județul Vrancea*. Analele Univ. Iaşi, Supliment, 38-44.
7. PAŞCOVSCHI S., DONIȚĂ N., 1967 - *Vegetația lemnoasă din silvostepa României*. Edit. Acad. R.S.R., Bucureşti.
8. POPESCU A., SANDA V., 1992 - *Coenotaxonomy decidous forests belongin to the Qouerco-Fagetea Br.-Bl. Et Vlieger 1937 class in Romania*. Revue roum. de Biol. Sér de Bot., 37,1: 15-26.
9. POPESCU GH., 1975 - *Pădurile de foioase din bazinul hidrografic al Bistriței-Vâlcii*. Studii şi Cerc. Subcomisia OMN a Olteniei. Drobeta Turnu-Severin, 133-140.
10. RADWAŃSKI J. M., FIERA C.W. WEINER M., 2006 - *A new species of Protaphorura Absolon, 1901 (Collembola: Onychiuridae: Onychiurinae) from Romania and a redescription of Protaphorura glebata (Gisin, 1952)* (in press).
11. ŞTEFAN N., 1981 - *Studiul fitocenotic asupra principalelor asociații vegetale lemnoase din bazinul superior al râului Râmnicul Sărat*. Studii şi Comunic. Ale Muz. Vrancea, Focşani, 4: 463-469.
12. ZIVADINOVIC J., CVIJOVIC M., 1967 - *Dynamik der Apterygotenpopulationen in der Waldgesellschaft Querco-Carpinetum Croaticum Hirvat*. [Orig.serbo-kroat.], Godisnjaka Biol. Inst. Univ. Sarajevo, 85-110.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE VEGETATION AND NATURAL AND ANTHROPIC FAUNA FROM THE BIG MARSHALL OF BRĂILA (INSULA MARE A BRĂILEI)

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ABSTRACT

SANDA V., VASILIU-OROMULU L., BARABAŞ N., BĂTBUCEANU D., RĂDUCU D., 2006 - The vegetation and natural and anthropic fauna from the Big Marshall of Brăila (Insula Mare a Brăilei). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 152-159.

The paper presents 30 Asssociations from the Big Marshall of Brăila Insula Mare a Brăilei, which *Elodeetum nuttalli* Ciocârlan et al. 1997, *Ambrosietum artemisiifoliae* Viţalariu 1973 are new for the area. The phytocoenological tables are attached to them.

The Thysanoptera insects, important indicators of the herbaceous layer of the meadow ecosystems, revealed a dynamical coenosis with a positive evolution. All the species are new records for the island; *Sericothrips staphylinus* are mentioned for the first time in the literature having as host plant *Glycine mas.* On the same plant, *Thrips tabaci* have produced galls and the TSWV tospovirus transmission has induced a negative, synergic effect.

Key words: anthropic , vegetation, fauna, Big Marshall of Brăila

Introduction

The extended changes to which was subjected the territory of the Insula Mare a Brăilei, like channel construction, land division, the anthropic impact being implicitly more and more actually, agresive in last years, resulted concomitantly to major changes in the structure of the vegetation in the area. The natural vegetation remained in the "Salcia" area only around the Zăton Lake, with numerous hydrophilic and hygrophylic phytocoenosis characteristic for this habitat.

Materials and methods

The representative sites were selected in the area "Salcia" in the meadow, forest, paludosus and agroecosystems.

RESEARCH STATIONS IN INSULA MARE A BRĂILEI

St. I – ***Hordeetum murini*** Libbert 1932 em. Pass. 1964
Agropyretum pectiniforme (Prodan 1939) Dihoru 1970
St. II – ***Xeranthemo cylindracei- Brometum arvensis*** Popescu Gh. 1992 [Syn.: *Brometum arvensis* (Şerbănescu 1957 n.n) Kiss 1964
Typhetum laxmannii Nedelcu 1969
St. III – ***Conietum maculati*** I. Pop 1968 **Zăton (border of lake)**
Arctio - Ballotetum nigrae (Felföldy 1942) Morariu 1943
St. IV – ***Triticum aestivum***
St. V – ***Glycine mas***
St. VI – ***Zea mays***
St. VII – ***Salicetum albae*** Issler 1924 s.l. planted forest **(Frecăţei)**

The coenotical structure of the ecosystems were done on the 10 representative surveys, conform to the central-European school (Pott, 1995). The insects were collected with the entomological net, 10 samples (1 sample = 50 sweeps) on each sites, in temporal dynamics.

Results and discussions

Coenotaxonomical conspectus

Lemnetea O. de Bolós et Masclans 1955
Lemnetalia minoris O. de Bolós et Masclans 1955
Lemnion minoris O. de Bolós et Masclans 1955

1. *Lemnetum minoris* Soó 1927
2. *Lemno-Salvinietum natantis* Miyavaki et J.Tx. 1960

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Hydrocharietalia Rübel 1933
Hydrocharition Rübel 1933
3.*Lemno-Hydrocharitetum* (Oberd. 1957) Pass. 1978
Ceratophyllion demersi Soó 1927 nom. nud.
4.*Ceratophylletum demersi* Hild. 1956
Potamogetonetea pectinati R. Tx. et Prsg. 1942
Potamogetonetalia pectinati W.Koch 1926
Potamogetion lucentis Rivas Martinez 1973
5.*Elodeetum nuttallii* Ciocârlan et al. 1997
Nymphaeion albae Obert. 1957
6.*Nymphaeetum albae* Vollmar 1947
7.*Nymphoidetum peltatae* (Allorge 1922) Bellot 1951
Phragmitetea australis R. Tx. et Preising 1942
Phragmitetalia Koch 1926
Phragmition communis Koch 1926
8.*Scirpo-Phragmitetum* W.Koch 1926
9.*Typhetum angustifoliae* Pignatti 1953
10. *Typhetum laxmannii* Nedelcu 1969
11. *Typhetum latifoliae* G. Lang 1973
12. *Schoenoplectetum lacustris* Chouard 1924
Nasturtio- Glycerietalia Pignatti 1953
Sparganio-Glycerion fluitantis Br.-Bl. et Sissingh 1942
13. *Sparganietum erecti* Roll 1938
Oenanthetalia aquaticae Hejný in Kopecký ex Hejný 1965
Oenanthion aquaticae Hejný ex Neuhäusl 1959
14. *Eleocharitetum palustris* Schennikov 1919
Festuco-Brometea Br.-Bl. et R.Tx. ex Klika et Hadač 1944
Festucetalia valesiacae Br.-Bl. et R.Tx. ex Br.- Bl. 1949
Festucion valesiacae Klika 1931
15. *Artemisio austriacae-Poëtum bulbosae* Pop 1970
16. *Agropyretum pectiniforme* (Prodan 1939) Dihoru 1970
17. *Botriochloëtum ischaemi* (Krist. 1937) Pop 1977
Stellarietea mediae Tx., Lohm. et Prsg.in R. Tx. 1950
Sisymbrietalia J.Tx. in Lohm. et al. 1962
Sisymbrion officinalis R.Tx., Lohm. et Prsg. in R.Tx.1950
18. *Hordeetum murini* Libbert 1932 em. PAsss. 1964
19. *Xeranthemo cylindracei - Brometum arvensis* Popescu Gh. 1992 [Syn.: *Brometum arvensis* (Şerbănescu 1957 n.n) Kiss 1964]
Atriplicion nitentis PAsssarge 1978
20. *Cynodonto-Atriplicetum tataricae* Morariu 1943
Plantaginetea majoris Tx. et Prsg. 1950
Plantaginetalia majoris Tx. (1947) 1950
Polygonion avicularis Br. – Bl. 1931 em. Tx. 1950
21. *Sclerochloo-Polygonetum avicularis* (Gams 1927) Soó 1940
22. *Trifolio fragifero- Cynodontetum* Br. – Bl. et Bolós 1958
Artemisietea vulgaris Lohm. et al in R.Tx. 1950
Onopordetalia acanthii Br. – Bl et R. Tx. ex Klika et Hadač 1944
Onopordion acanthii Br. – Bl et al 1936
23. *Onopordetum acanthii* Br. – Bl et al 1936
Brachyaction ciliatae Pop et Viţalariu 1971
24. *Ambrosietum artemisiifoliae* Viţalariu 1973
Arction lappae R. Tx. 1937
25. *Arctio – Ballotetum nigrae* (Felföldy 1942) Morariu 1943
26. *Conietum maculati* Pop I. 1968
27. *Tanaceto- Artemisietum vulgaris* Br. – Bl. 1949
Galio - Urticetea Passarge 1967 em. Kopecký 1969
Lamio albi-Chenopodietalia boni-henrici Kopecký 1969
Galio-Alliarion Lohm. et Oberd. 1967 in Oberd. et al 1967
28. *Sambucetum ebuli* Felföldy 1942
Convolvuletalia sepium R. Tx. 1950 em. Mucina 1993
Senecionion fluviatilis R.Tx. 1950
29. *Glycyrrhizetum echinatae* Slavnič 1951
Salicetea purpureae Moor 1958
Salicetalia purpureae Moor 1958
Salicion albae Soó 1930 em. Müller Th. ex. Görs 1958
30. *Salicetum albae* Issler 1924 s.l.

The short characterization of the vegetation

Emergence aquatic vegetation is composed of *Lemna minor, Salvinia natans* and *Hydrocharis morsus-ranae* (Ass. 1-3 in the conspectus), which are present being sheltered by reeds or present between the free water of which the Zăton Lake. These phytocoenosis are found also in the irrigation channels, especially in the area of the Zăton and Mărașu farm, the channels being in advanced stages of clogging. In this area are encountered too, submerged coenosis composed of *Ceratophyllum demersum* (Ass.4) and *Elodea nuttallii* (Ass.5). We discovered the last association, described only in the Danube Delta (1.5), in an irrigation channel in North-West area of Mărașu farm (Table 1). The phytocoenosis presented a coverage of (70-90%) and had Ass accompanying species: *Ceratophyllum demersum, Hydrocharis morsus-ranae, Potamogeton crispus, Lemna minor, Spirodela polyrhiza, Salvinia natans* etc.

In the Zăton Lake, at limit of the reed belt towards the water surface are present representative phytocoenoses of the association *Nyphaeetum albae* Wollmar 1947 on about 200 sqm.

The associations realized by *Nymphoides peltata* are seldom in the territory and encountered them both in the irrigation channels, in Mărașu, and around the Frecăţei commune, being present especially under the protection of the reed belt.

Paludous vegetation was dominated by *Phragmites australis* (Ass. 8) which was often found both around the Zăton Lake, forming islet phytocoenosis of different sizes. Intercalary to them, could be encountered *Typha latifolia* (Ass.11), *T. angustifolia* (Ass.9) and *T.laxmannii* (Ass.10) coenosis, which are frequently accompanied by *Schoenoplectus lacustris* (Ass.12).

The asssociations realized by *Sparganium erectum* (Ass.13) were found around the Zăton Lake where they reached the height of 6-70 cm and had a medium coverage of 85-90%. We can mention more frequent: *Rorippa amphibia, Butomus umbellatus, Sagittaria sagittifolia, Mentha aquatica, Alisma plantago-aquatica, Polygonum amphibium, Galium palustre, Carex hirta, Sium latifolium, Cyperus fuscus* and *Cyperus serotinus* among the accompanying species (Fig. 1).

Fig. 1 - *Cyperus serotinus* element characteristic to the phytocoenoses of *Sparganium erectum* present at the border of Zăton lake.

The phytocoenoses of the *Eleocharidetum palustris* Schennikov 1919 association were present on large surfaces, in small depressions located at South-West side of Frecăţei commune.

The dike vegetation was composed of meso-xerophylous phytocoenosis toward xerophylous (Ass. 15.16, 17, 18, 19, 20) dominated in vernal period by *Hordeum murinum*, *Poa bulbosa, Agropyron pectiniforme,* and summer those towards autumnal those by *Atriplex tatarica, Artemisia austriaca* and *Botriochloa ischaemum.*

The access ways are limited by *Polygonum aviculare* (Ass.21) and *Cynodon dactylon* (Ass.22), and on large surfaces was encountered *Onopordon acanthium* (Ass.23), which composed high phytocoenoses.

Around Zăton Lake, close to farm there was found exemplars of *Ambrosia artemisiifolia,* an adventive plant of North-American origin, which spread more and more in our country in the last years (Ass. 6, 8, 9) (Fig. 2).

Fig. 2 - Phytocoenoses of *Ambrosia artemisiifolia* distribuite at the plantation border of *Salix alba* in Frecăţei commune.

Around the Frecăţei commune there were found representative phytocoenosis (Ass.24, Table 2), groups described until present only in Moldova (Site CFR. Triaj, Socola-Iaşi) (9) and now mentioned the species near Bucharest, in Tunari, on the belt road, where were well developed numerous exemplars.

The phytocoenoses of *Glycyrrhiza echinata* (Ass.29) were identified around the Zăton Lake, while farm abundant groups of *Conium maculatum* (Ass.26), *Artemisia vulgaris* and *Tanacetum vulgare* (Ass.27), Ass well Ass of *Sambucus ebulus* (Ass.28) grow on the domestic wastes around Zăton.

They develop especially where huge quantities of garbage deposits are present. The phytocoenosis begin to regress, as these exhausted, although they maintained as separate individuals, several successive years.

The wood vegetation dominated on border of the Frecăţei commune, where plantations enough old of *Salix alba* (Ass.29) were encountered. The land was flooded in 2005 a long interval, the water being present even at end of August on certain areas. The accompanying species, more frequent in these phytocoenosis, are: *Amorpha fruticosa, Polygonum hydropiper, Rubus caesius, Eupatorium cannabinum, Rumex sanguineus, Althaea cannabina, Agrostis stolonifera, Aristolochia clematitis,* etc.

Sometimes, the flooding level reached even 1-2 m, Ass the adventives roots, the so called „moustaches” found on the *Salix alba* trunks showed.

Tab. 1 - *Elodeetum nuttallii* Ciocârlan et al. 1997

No. survey	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**K**
Coverage (%)	80	85	90	80	90	70	80	85	
Water deep (cm)	85	90	100	70	50	80	95	120	
Suprface (m^2)	10	15	8	7	10	20	15	6	
Car. Ass.									
Elodea nuttalii	5	5	4	5	5	3	5	5	V
Ceratophyllum demersum	1	+	1	.	+	1	1	+	V
Potamion + Potametalia									
Potamogeton crispus	+	+	.	+	1	+	.	+	IV
Potamogeton pusillus	+	.	+	.	+	.	+	.	III
Hydrocharition									
Hydrocharis morsus- ranae	+	.	+	+1	.	.	+	+	IV
Salvinia natans	.	+	.	+	.	+	.	+	III
Lemnion minoris									
Lemna minor	+	.	+	.	+	+	+	.	IV
Lemna trisulca	.	+	.	+	+	+1	.	+	IV
Spirodela polyrhiza	.	+	.	+	.	.	+	.	II
Phragmition communis									
Phragmites australis	.	.	.	+	.	.	.	+	II

The place and the date of the surveys: 1-8, Mărașu (County Brăila), 23.08.2005

Tab. 2 - *Ambrosietum artemisiifoliae* Vițalariu 1973

No. survey	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**K**
Surface (m^2)	50	100	100	100	100	100	100	100	100	100	
Height veget. (cm)	35	40	45	40	35	40	35	45	50	50	
Coverage (%)	75	80	85	80	75	70	65	60	75	80	
Car. Ass.											
Ambrosia artemisiifolia	4	4	4-5	4	4	4	4	3-4	4	4	V
Brachyaction ciliatae											
Erigeron canadensis	+	.	+1	+	+1	.	+	+	+	.	IV
Xanthium strumarium	+	+	.	+	+	+	.	+	+	+	IV
Artemisia annua	+	+1	.	+1	+	.	+	.	.	+	III
Amaranthus blitoides	+	.	.	+	+	+	.	+	.	.	III
Diff. halophilous											
Atriplex tatarica	+	+1	+	+1	+	+	.	.	.	+	IV
Trifolium fragiferum	+	+	+1	.	+	+	+	.	+	.	IV
Mentha pulegium	+	+1	.	+	+	+	.	+	.	+	IV
Onopordetalia											
Carduus acanthoides	+	+	+	.	+	+	+	+1	.	.	IV
Centaurea solstitialis	+	.	+	.	+	.	.	.	.	+	II
Althaea cannabina	+	.	+	+	.	+	.	.	.	+	III
Onopordum acanthium	+	.	+	+	+	+	.	.	.	+	III
Artemisietea + Stellarietea mediae											
Matricaria inodora	+	+	+	.	.	+	.	.	.	+	III
Setaria glauca	+	.	+	+	+	+	.	.	.	+	III
Chenopodium album	+	.	.	+	.	.	.	.	.	+	II
Convolvulus arvensis	+	+	+	+	+	+	.	.	.	+	IV
Cirsium arvense	+	.	+	+	+	.	+	+	+	.	IV
Digitaria sanguinalis	+	+	.	.	+	.	.	.	.	.	II
Echinochloa crus-galli	+	.	+	+	.	.	.	.	+	.	II

Polygonum persicaria	+	.	.	+	.	+	.	.	+	+	III
Cardaria draba	+	.	+	.	+	.	.	.	+	.	II
Lactuca serriola	+	+	.	+	.	+	+	.	.	.	III
Anthemis arvensis	+	+	.	+	.	.	+	.	.	+	III
Abutilon theophrAssti	+	+	.	+	.	+	.	+	.	.	III
Diff. coenotaxa											
Cichorium intybus	+	+	+	+	+	+	.	.	+	+	IV
Polygonum aviculare	+	.	.	.	.	+	+	.	.	+	II
Daucus carota	+	.	+	.	.	+	.	+	.	.	II
Plantago lanceolata	+	.	+	+	.	+	.	.	+	+	III
Agropyron repens	+	+	+	.	.	.	.	+	.	+	III
Taraxacum oficinallis	+	.	.	+	+	.	.	.	+	.	II
Poa annua	+	+	.	.	+	.	.	.	.	+	II
Trifolium repens	+	.	.	.	.	.	.	.	+	+	II
Cynodon dactylon	+	.	.	.	.	+	.	+	.	+	II
Eragrostris minor	+	+	.	.	.	.	+	.	.	.	II
Medicago lupulina	+	.	.	.	.	+	.	.	.	+	II
Rorippa austriaca	+	.	.	.	.	+	.	.	.	.	I
Plantago media	+	.	+	.	+	.	.	.	.	.	II
Rorippa sylvestris	+	.	.	.	.	.	.	.	.	.	I
Agrostris stolonifera	+	+	+	.	.	.	.	.	+	.	II
Verbena officinalis	+	+	.	.	.	+	.	.	.	+	II
Lotus corniculatus	+	.	.	.	.	+	.	.	.	.	I
Gratiola officinalis	+	.	.	.	+	+	.	.	.	.	II

The place and the date of the surveys: Frecăței, County Brăila, 1-6: 24.08.2005; 6-10, 25.08.2005

The terrestrial ecosystems have, in their zoocoenosis structure of the herbaceous layer, important bioindicators of the equilibrium state or of the anthropic impact.

This bioindicators are the insects from the Ord. Thysanoptera, which have a large distribution from the sea level till 3500 m high, from the warm area till arctic zone, and there are cosmopolitans or endemics. There belongs to two trophic modules, the phytophagous, generally and the zoophagous, rare.

In the Big Marshland of the Brăila (Insula Mare a Brăilei) in the studied meadows, forests and agroecosystems were identified 21 Thysanoptera species, generally praticolous.

In the site characterized by the associations *Hordeetum murini* and *Agropyretum pectiniforme* the Thysanoptera communities are the richest from the specific spectrum point of view and from the structural and functional indices.

The average density of 228 ind/m^2 reveals a dynamics coenosis, with a positive evolution.

The matter transfer and the enerergetical flux are active in the frame of the Thysanoptera populations in the *Xeranthemo cylindracei-Brometum arvensis* association, where the value of the Shannon-Weaver index is high, near of those from the mountainous meadows (Table 3). In the herbaceous layer of the forest, after the water desecation there were installed low quantitative and qualitative Thysanoptera populations, with only praticolous species.

In the Triticum site, the characteristic species *Thrips tabaci* and *Haplothrips tritici*, were present, but in very low number, due to the utilized insecticides in the pest control.

For the first time in the literature we mention the species *Sericothrips staphylinus* on *Glycine mas* distributed on the whole crop, in the Big Marshland of the Brăila.

The species *Thrips tabaci* produced galls on some plants non revealed aspect till now.

On the site *Zea mays* there were identified characteristic thrips species on this plant species, and those from the weeds grown in this culture.

Tab. 3 - The species, ecological characteristics and geographical distribution

Ord. Thysanoptera

Subord. Terebrantia

Species	**Ecological characteristics**	**Geographical distribution**
	Fam. Aeolothripidae	
Aeolothrips fasciatus	Coronilla varia, Plantago lanceolata, V-IX, me, fl, po, pr	HOL
Melanthrips fuscus	Euphorbia cyparissias, Sinapis arvensis, V-VIII, me, fl, po	WPAL
	Fam. Thripidae	
Aptinothrips rufus	Cardaria draba, Vinca herbacea, IV-X, eu, te, xt, gr, po	COS
Chirothrips manicatus	Poa pratensis, Anthemis tinctoria, IV-X, eu, me, gr, po	HOL
Frankliniella intonsa	common, IV-X, xet, fl, po, eu, TSWV, TCSV, GRSV	EUS
Frankliniella pallida	Medicago falcata, Dorycnium herbaceum, V-VIII, xe, fl, po	EUR
Kakothrips robustus	Pisum sativum, V-VIII, xe, fll, ol, po	EUR
Sericothrips staphylinus	Vicia cracca; Lotus corniculatus,VI-VIII me, fl, po	EUR
Thrips atratus	Anthyllis vulneraria, Hypericum perforatum, Colchicum autumnale, IV-IX, me, fl, po	PAL
Thrips fuscipennis	Prunus spinosa; Carpinus betulus, Centaurea rhenana; IV-X, me, fl, fo, po	PAL
Thrips major	Althaea officinalis, Helianthemum nummularium, Lytrum salicaria; IV-IX, me, fl, po	WPAL
Thrips minutissimus	Viburnum lantana, Crataegus laevigata, V-IX, ar, fl, fo, me, po	EUR
Thrips physapus	Leontodon hispidus,Centaurea mollis, IV-IX, me, fl, po, SRN	EUS
Thrips tabaci	common, me, fl, fo, po, TSWV	COS
Thrips trehernei	Taraxacum officinalis, Convolvulus arvensis, IV-IX, me, fl, po	HOL
Thrips validus	Taraxacum officinale, Tussilago farfara, Plantago lanceolata, V-IX, me, fl, po	EUS
	Subord. Tubulifera **Fam. Phlaeothripidae**	
Haplothrips aculeatus	Dactylis glomerata, Poa pratensis, IV-IX, eu, me, gr, po, pr	PAL
Haplothrips leucanthemi	Leucanthemum vulgare, V-VIII, me, fl, po	EUS
Haplothrips niger	Trifolium repens, Achillea setacea, V-VIII, me, fll, po	EUS
Haplothrips reuteri	Anthemis tinctoria, Carduus nutans, IV-IX, me, fl, po	PON-MED
Haplothrips tritici	poacee, V-VIII, me, gr, po, pr	WPAL

The abbreviations explanation

Ecological	**characteristic**	**Trophic relation**	**Trophic spectrum**	SRN = resistant species at the atmospheric pollutants
eu=eurioec	ar=arboricolous	ol=oligophagos	po=poliphagous	SVV = species vector for viruses:
me=mesophilous	fl=floricolous		pr=predator	TSWV, TCSV, GRSV *Frankliniella intonsa****
te=termophilous	fo=folicolous			TSWV *Thrips tabaci* *
xt=xerothermic	gr=graminicolous			

Geographical distribution	
COS=Cosmopolitan	PAL=Palaearctic
EUR=European	PON-MED=Pontomediterranean
EUS=Eurosiberian	SBM=Submediterranean
HOL=Holarctic	WPAL=Westpalaearctic

Tab. 4 - The structural and functional indices of the thrips populations

June	-					f.w.	d.w.	energ.metab.			
site I Hordeum	x/m^2	s^2	STDEV	s'	CV	$/m^2$	$/m^2$	ml O_2/m^2	A%	C%	$p_i \log p_i$
Haplothrips larve	6	1.8	1.3	0.27	224	4.8	0.6	0.12	100	20	0
∑	**6**	1.8	1.3	0.27	224	**4.8**	**0.6**	**0.12**	100		0
site I Agropyretum				**H(S)**	**0**	$\mathbf{H_{max}}$	**0**	**E%**	**0**		
Melanthrips fuscus	4	0.8	0.9	0.18	224	3.2	0.4	0.08	1.80	20	-0.031
Chirothrips manicatus	18	1.2	1.1	0.22	61	14.4	1.8	0.36	8.11	80	-0.088
Frankliniella intonsa	4	0.8	0.9	0.18	224	3.2	0.4	0.08	1.80	20	-0.031
Haplothrips aculeatus	18	12.2	3.5	0.70	194	14.4	1.8	0.36	8.11	40	-0.088
Haplothrips leucanthemi	110	126.5	11.2	2.25	102	88.0	11.0	2.20	49.55	80	-0.151
Haplothrips niger	58	25.2	5.0	1.00	87	46.4	5.8	1.16	26.13	80	-0.152
Haplothrips reuteri	10	5.0	2.2	0.45	224	8.0	1.0	0.20	4.50	20	-0.061
∑	**222**	398.7	20.0	3.99	1114.5	**177.6**	**22.2**	**4.44**	100		-0.604
site II Xeranthemum				**H(S)**	**2**	$\mathbf{H_{max}}$	**3**	**E%**	**71**		
larvae	10	5.0	2.2	0.45	223.6	8.0	1.0	0.20	11.1	20	-0.106
Frankliniella intonsa	2	0.2	0.4	0.09	223.6	1.6	0.2	0.04	2.2	20	-0.037
Thrips atratus	4	0.8	0.9	0.18	223.6	3.2	0.4	0.08	4.4	20	-0.060
Thrips major	4	0.8	0.9	0.18	223.6	3.2	0.4	0.08	4.4	20	-0.060
Thrips tabaci	42	18.2	4.3	0.85	101.6	33.6	4.2	0.84	46.7	60	-0.154
Thrips physapus	12	4.7	2.2	0.43	180.7	9.6	1.2	0.24	13.3	40	-0.117
Thrips validus	14	4.8	2.2	0.44	156.5	11.2	1.4	0.28	15.6	40	-0.126
Sericothrips staphylinus	2	0.2	0.4	0.09	223.6	1.6	0.2	0.04	2.2	20	-0.037
∑	**90**	93.5	9.7	1.93	107.4	**72.0**	**9.0**	**1.80**	100	240	-0.697
site III Conietum				**H(S)**	**2.31**	$\mathbf{H_{max}}$	**3**	**E%**	**77.1**		
Aeolothrips fAssciatus	6	1.8	1.3	0.27	223.6	4.8	0.6	0.12	14	20	-0.118
Frankliniella intonsa	16	12.8	3.6	0.72	223.6	12.8	1.6	0.32	36	20	-0.160
Thrips atratus	12	7.2	2.7	0.54	223.6	9.6	1.2	0.24	27	20	-0.154
Thrips trehernei	10	5.0	2.2	0.45	223.6	8.0	1.0	0.20	23	20	-0.146
∑	**44**	96.8	9.8	1.97	223.6	**35.2**	**4.4**	**0.88**	100		-0.578
site IV Triticum				**H(S)**	**2**	$\mathbf{H_{max}}$	**2**	**E%**	**96**		
Aptinothrips rufus	8	3.2	1.8	0.36	223.6	6.4	0.8	0.16	17	20	-0.132
Frankliniella intonsa	8	3.2	1.8	0.36	223.6	6.4	0.8	0.16	17	20	-0.132
Thrips tabaci	24	12.8	3.6	0.72	149.1	19.2	2.4	0.48	52	40	-0.147
Haplothrips tritici-larve	6	1.8	1.3	0.27	223.6	4.8	0.6	0.12	13	20	-0.115
∑	**46**	25.8	5.1	1.02	110.4	**36.8**	**4.6**	**0.92**	100	100	-0.527
site V Glycine				**H(S)**	**2**	$\mathbf{H_{max}}$	**2**	**E%**	**87.54**		
Thrips tabaci	16	12.8	3.6	0.72	224	12.8	1.6	0.32	100	20	0
∑	**16**	12.8	3.6	0.72	224	**12.8**	**1.6**	**0.32**	100		0
August				**H(S)**	**0**	$\mathbf{H_{max}}$	**0**	**E%**	**0**		
site III Conietum											
Kakothrips robustus	16	12.8	3.6	0.72	223.6	12.8	1.6	0.32	36	20	-0.160
Frankliniella pallida	4	0.8	0.9	0.18	223.6	3.2	0.4	0.08	9	20	-0.095
Frankliniella intonsa	16	6.8	2.6	0.52	163.0	12.8	1.6	0.32	36	40	-0.160
Thrips tabaci	8	3.2	1.8	0.36	223.6	6.4	0.8	0.16	18	20	-0.135
∑	**44**	48.8	7.0	1.40	158.8	**35.2**	**4.4**	**0.88**	100		-0.549
site VI Zea				**H(S)**	**2**	$\mathbf{H_{max}}$	**2**	**E%**	**91**		
Chirothrips manicatus	4	0.8	0.9	0.18	224	3.2	0.4	0.08	5.41	20	-0.068
Frankliniella intonsa	12	7.2	2.7	0.54	224	9.6	1.2	0.24	16.22	20	-0.128
Thrips tabaci	6	1.8	1.3	0.27	223.6	4.8	0.6	0.12	23	20	-0.147
Haplothrips aculetus	10	2.0	1.4	0.28	141	8.0	1.0	0.20	13.51	20	-0.117
Haplothrips tritici	22	19.2	4.4	0.88	199	17.6	2.2	0.44	30	40	-0.157
Haplothrips larve	26	13.8	3.7	0.74	143	20.8	2.6	0.52	35	40	-0.160
∑	**74**	43	13.1	2.62	930.69	**59.2**	**7.4**	**1.48**	100		-0.630
site V Glycine				**H(S)**	**2.09**	$\mathbf{H_{max}}$	**3**	**E%**	**81**		
Sericothrips staphylinus	24	5.3	2.3	0.46	96	19.2	2.4	0.48	63	80	-0.126
Thrips tabaci	14	4.3	2.1	0.41	148	11.2	1.4	0.28	37	60	-0.160
∑	**38**	17.2	4.1	0.83	109	**30.4**	**3.8**	**0.76**	100		-0.286
site VII Salicetum-herbal				**H(S)**	**0.95**	$\mathbf{H_{max}}$	**1**	**E%**	**95**		
Frankliniella intonsa	6	1.8	1.3	0.27	224	4.8	0.6	0.12	18.75	20	-0.136

Thrips atratus	2	0.2	0.4	0.09	224	1.6	0.2	0.04	6.25	20	-0.075
Thrips fuscipennis	10	5.0	2.2	0.45	224	8.0	1.0	0.20	31.25	20	-0.158
Thrips minutissimus	2	0.2	0.4	0.09	224	1.6	0.2	0.04	6.25	20	-0.075
Haplothrips aculeatus	8	3.2	1.8	0.36	224	6.4	0.8	0.16	25.00	20	-0.151
Haplothrips leucanthemi	2	0.2	0.4	0.09	224	1.6	0.2	0.04	6.25	20	-0.075
Haplothrips niger	2	0.2	0.4	0.09	224	1.6	0.2	0.04	6.25	20	-0.075
∑	**32**	10.8	7.16	1.43	224	**25.6**	**3.2**	**0.64**	100		-0.746
				H(S)	**2**	**H_{max}**	**3**	**E%**	**88**		

Conclusions

● The natural vegetation of Insula Mare a Brăilei (The Big Marshland of Brăila) was much affected by the anthropic factor, by the numerous carried out interventions. To note the presence of the natural hydrophilic and hygrophilous phytocoenosis around Zăton Lake;

● The xero-mesophylous groups on dikes were strongly influenced by the anthropic factor, which explains the massive presence of numerous phytocoenoses of *Artemisietea vulgaris* Class, being in continuous expansion;

● The phytocoenosis composed of *Elodea muttallii, Ambrosia artemisiifolia* and *Glycyrrihiza echinata* are new for the area;

● The important bioindicators of the herbaceous layer, the insects Thysanoptera were characteristics for the grasslands sites, revelled a dynamics coenosis, with positive evolution;

● All the identified species were new record for Insula Mare a Brăilei (The Big Marshall of Brăila);

● The sites *Hordeetum murini* and *Agropyretum pectiniforme* had the highest values of the structural and functional indices of the Thysanoptera populations;

● In the sites- *Triticum aestivum* and *Zea mays* were identified thrips species characteristic for this plant species;

● For the first time in the literature we mention the species *Sericothrips staphylinus* having as host plant *Glycine mas*. The species *Thrips tabaci* determined numerous galls on the host plant aspect none revealed till now.

References

1. CIOCÂRLAN V., SÂRBU I., ŞTEFAN N., MARIAN T., 1997 - *Elodea nuttalii (Plachon) St. John, specie nouă în flora României*. Bul. Grăd. Bot. Iaşi 6, fasc.1: 213-215.
2. NEDELCU G. A., 1980 - *Vegetaţia palustră din împrejurimile oraşului Brăila*. Studii şi Cerc. de Biol. Seria Biol. Veget., 32, 1: 39-46.
3. NEDELCU G. A., 1981 - *Vegetaţia acvatică şi palustră din împrejurimile oraşului Brăila (II). Vegetaţia acvatică*. Acta Bot. Horti. Buc. 1979-1980, Buc., 165-174.
4. SANDA V., 2002 - *Vademecum ceno-structural privind covorul vegetal din România*. Edit. Vergiliu, Bucureşti, 331 pg.
5. ŞTEFAN N., Oprea Ad., 2001 - *Vegetaţia Ostrovului Cernovca* (I). Bul.Grăd. Iaşi 10, 123-143.
6. ŢOPA E., BOŞCAIU N., 1965, *O buruiană periculoasă: Ambrosia artemisiifolia L., în România*. SSNG. Comunic. de Bot., 3, 131-136.
7. VASIU V., DÂRLĂU C., CÂMPEANU L., 1959 - *Pajiştile naturale din balta Ialomiţei*. Analele Inst. de Cerc. Agron. Seria B, 27, 113-145.
8. VASILIU-OROMULU L., 1994 - *Ecological monitoring in Thysanopterology, in "Courier Forschungsinstitut Senckenberg"*, 178: 101-106, Frankfurt am Main.
9. VASILIU-OROMULU LILIANA, 1995 - *Population Diversity of Thysanoptera in Romanian Meadows, in, "Thrips Biology and Management"*, Edited by B.L.Parker et al., Plenum Press, New York, NATO ASSI, Series A: Life Sciences Vol. 276: 469-477.
10. VASILIU-OROMULU LILIANA, 2002 - *The temporal and spatial dynamics of the thrips populations from the mountainous meadows*, Thrips and tospoviruses: Ed.Marullo & Mound, Publisher Australian National Insect Collection, Canberra, 295-313.
11. VASILIU-OROMULU LILIANA, 2002 - The *dynamic of the sex ratio index of thrips populations in mountainous meadows*, Thrips and tospoviruses: Ed.Marullo & Mound, Publisher Australian National Insect Collection Canberra, 315-324.
12. VASILIU-OROMULU LILIANA, 2004 - *Cap. Ord. Thysanoptera, in Fauna Europaea*, Ed. Cristal Print, 366-372, Cluj
13. VICOL E.C., 1971 - *Un alergen periculos pe cale de răspândire: Ambrosia artemisiifolia* L. Studii şi Cerc. de Biol. Seria Bot., 23, 5: 461-466.
14. VIŢALARIU G., 1973 - *Contribuţii la cunoaşterea vegetaţiei ruderale din Moldova*. Studii şi Comunic. Şt. Nat. Bacău, 6, 333-342.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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THE MATHEMATIC MODEL FOR THE MONITORING OF THE CROPS AND SPONTANEOUS VEGETATION ON THE DAMMED AREAS

VALENTIN PANAIT*

ABSTRACT

PANAIT V., 2006 - The mathematic model for the monitoring of the crops and spontaneous vegetation on the dammed areas. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 160-163.

Within this paper there are exposed a few aspects regarding the monitoring of the soils, crops and spontaneous vegetation evolution.

In this purpose, using the mathematical models and the data obtained after years of study on Murighiol-Dunavăţ dammed area we obtained the following results:

1. A positive evolution of the soil's organic matter concentration, spontaneous vegetation and crops productivity, is concentrate to an optimum value of the environment factors.
2. A normal distribution of the spontaneous vegetation and crops in function of air temperature.
3. The evolution, in function of the air temperature, of the spontaneous vegetation and crops productivity (t/ha/year), as well as the evolution of the storage processes of the organic matter in the soil.
4. At the last we analyzed the evolution of the spontaneous vegetation and crops productivity (t/ha/year), in function of the evolution of the storage processes of the organic matter in the soil and vice-versa.

Key words: mathematical model, logistic grow, Gauss curve, agricultural dammed areas

Introduction

Within this paper there are exposed a few aspects regarding the monitoring of the soils, crops and spontaneous vegetation evolution, in the frame of the dammed and drainage areas of the Danube Delta Biosphere Reserve.

In this purpose, the mathematical models are very useful in order to understand the evolution of the agricultural dammed areas and offer a good platform for simulation of the soil, vegetation and crops evolution, as well as an analyzing tool of the different processes within the agricultural dammed areas.

Material and method

The stages necessary for the elaboration of this paper are the following ones:

- documentation concerning the initial status of the studied area, presented in the reports and/or technical projects elaborated on the occasion of the damming and draining works;
- study of the cartographical and cadastral materials, actual legislation and the scientific bibliography, in order to evaluate the legal situation and the present day state of the different land areas from the precincts;
- performing land observation, the result's centralization and the data analyzing;
- the establishing of the optimal mathematical model and its implementation;
- the evolution of the environment factors analysis and the comparison between the obtained data and those found in the scientific bibliography or in other published papers;
- determining the errors and correction of the mathematical model;
- the ending of the mathematical model and the processing the data in graphical format.

Results and discussions

The necessary stages, in order to achieve the mathematical model, are the following one:

1. The parameters selection.

The data obtains, on the frame of the Murighiol-Dunavăţ dammed area, these were used to the choosing of the environment parameters, as well as at the place of them within the mathematical model.

The environment parameters choose were split in two classes, as follows:

1.input value (relief, geological aspects, air temperature, rainfall, fresh water etc.) = x;

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2.output value (soil characteristics, crops and spontaneous vegetation productivity) = *y*;
all these could be shown as in Figure 1.

Fig. 1 – The mathematical model structure

In Figure 1, the *n* coefficient (n = 0, 1, 2, 3,…, i-1, i) represents the value, measured in time, of each property evolution.

2. Mathematical modelling of the system.

It is a very important stage of this study because it offers useful information about the factors that could be used in order to establish the input and output values, as well as the feedback loop.

The first step is represented by the some changes, in that mathematical model, these were imposed by the relation between soil and plants. In each terrestrial ecosystem, any change occurred in the soil can modify the vegetal productivity and repartition, and vice-versa.

In that case, the model can appeared as in the second figure (Fig. 2).

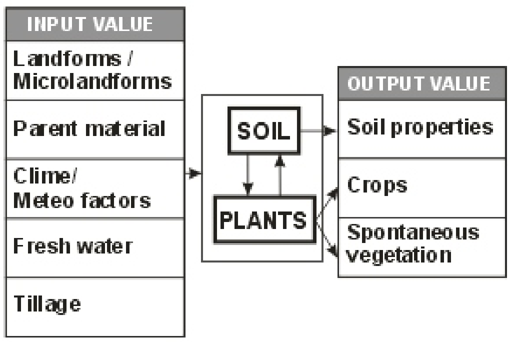

Fig. 2 – The in that diagram of the mathematical model the feedback loop is represented by interaction between soil and plants

In order to understood the interaction between the parts of the mathematical model that was divided into three modules, as follows:

1. The module Input value – Plants;
2. The module Input value – Soil;
3. The module Soil – Plants.

Because, the study of the entire influence of the input value towards soil-plants complex its is far from the our purposes, we choose only the interactions air temperature – plants, air temperature – soil (organic matter concentration) and between plants and soil.

Because, within the firsts two module we can use the same type of mathematical formulas these were analysed together.

The first problem in the case of all the mathematical models is represented by the continuity of the recorded data. The data discontinues type are not a good starting point.

In that case, the assurance of the data continuity was the leading part of the first type of modules.

That was occurring through the series of the calculus methods.

First, we could wrote the formula of the logistic grow, as follow:

$$\frac{dP}{dt} = P \cdot r \cdot \left(1 - \frac{P}{K}\right) \qquad (1)$$

were:
P – population;
r – proportionalities constant;
K – carrying capacity of environment;
t – time.

Then, we used that formula in order to established a relation between independent and dependent variables, in the following way:

$$\frac{dP}{dt} = \frac{dy}{dt}$$

$$\frac{dx}{dt} = (a - by)x$$

$$\frac{dy}{dt} = (cx - d)y$$

were:
x – independent variable;
y – dependent variable;
t – time;

these become:

$$\frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{dy}{dx} = rY\left(1 - \frac{y}{Y}\right) \qquad (2)$$

Y = (C-D)/(A-B)X

were:
x – independent variable;
y – dependent variable;
t – time;
Y – *carrying capacity of environement.*

Nevertheless, the logistical equation has a high disadvantage, because it stipulates the existence of the highest and lowest points, in evolution of the dependent variable. As far as from the median value will be the variation (low or high) of the independent variable value those limits of the dependent variable evolution can not be undone.

That purpose is far from the natural evolution of the dependent variable. Because, on the nature the values of the soil characteristics and vegetation productivity increase between lowest and optimal value of the independent variable (ex. air temperature) and these decrease between the optimal and highest value of the independent variable. In this case, is easy to observe the similarity between the natural evolution of the dependent variable and the shape of the Gaussian distribution. The Gauss curve is described by the following function (after Laherrère J.H., 2000):

$$f(x;\mu,\sigma)=\frac{X}{\sigma\sqrt{2\pi}}\times e^{-\frac{(x_i-\mu)^2}{2\sigma^2}} \qquad (3)$$

$$\mu=\frac{1}{n}\sum_{i=1}^{n}x_i$$

$$\sigma^2=\frac{1}{n}\sum_{i=1}^{n}(x_i-\mu)^2$$

$$\sigma=\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i-\mu)^2}$$

were:
X – the high value on x-axis;
x_i – the random variable (i = 1, 2, ... n-1, n);
μ – arithmetical mean;
δ^2 – variance;
δ – standard deviation.

Solving the differential equation (2) and modifying that according to the Gaussian distribution formula (3), we could obtain the following equations:

$$y=Y(1-(\frac{(x_i-\mu)^2}{2\sigma^2}))$$

were:
Y – the high value on y-axis of dependent variable or carrying capacity of environment;
x_i – the independent variable (i = 1, 2, ... n-1, n);
μ – arithmetical mean;
δ^2 – variance;
δ – standard deviation.

That equation can be use to acquire a continuity of the recorded data and that can be usefully to the analysing of the vegetal productivities and soil characteristics evolution.

The module Soil – Plants can be described using the following equations:

$$s=S(1-(\frac{(p_i-\mu)^2}{2\sigma^2}))$$

$$p=P(1-(\frac{(s_i-\mu)^2}{2\sigma^2}))$$

$p_i = 0{,}1p$
$s_i = 0{,}01s$

were:
s – the soil characteristics value;
p - the vegetal biomass;
S – the high value of the soil characteristics or carrying capacity;
P – the high value of the plants productivity or carrying capacity;
p_i – quantity of the vegetal organic matter available for soil (i = 1, 2, ... n-1, n);
s_i – quantity of the soil's fertility factor available for plants (i = 1, 2, ... n-1, n);
μ – arithmetical mean;
δ^2 – variance;
δ – standard deviation.

The evolution in time of the environment factors, crops, spontaneous vegetation and soil characteristics, can be trace with the following the data offers of the previously equations.

Conclusions

Using these equations and the data obtained after years of study on Murighiol-Dunavăț dammed area we obtained the following results:

1. A positive evolution of the soil's organic matter concentration, spontaneous vegetation and crops productivity, is concentrate to an optimum value of the environment factors. If the environment factors values are low or high the balance productivity-consume is inclined to consume (the productivity appear with minus).
2. In the first stage of the mathematical modelling, we obtained a normal distribution of the spontaneous vegetation (Fig. 3) and crops (Fig. 4) in function of air temperature.

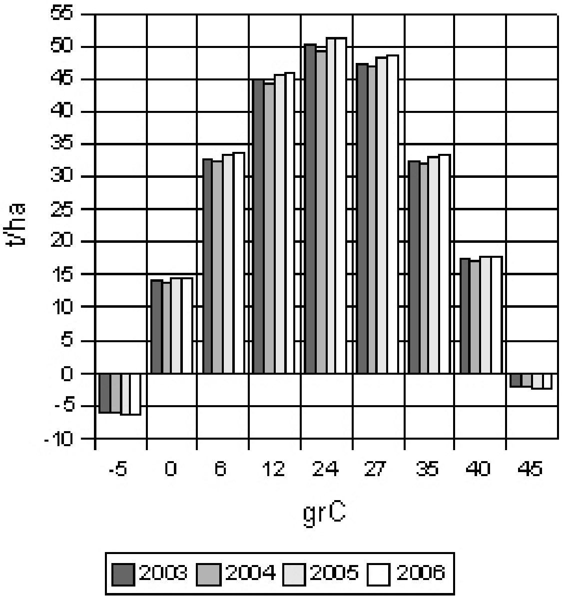

Fig. 3 – Spontaneous vegetation productivity in function of the air temperature

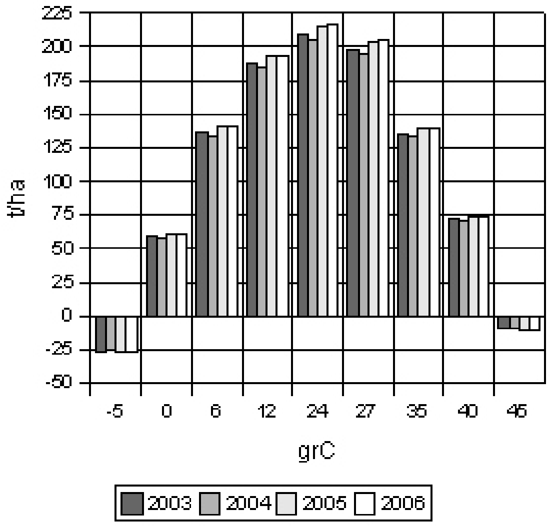

Fig. 4 – Crops productivity in function of the air temperature

3. In second stage we analyzed the evolution, in function of the air temperature, of the spontaneous vegetation and crops productivity (t/ha/year), as well as the evolution of the storage processes of the organic matter in the soil (Fig. 5).

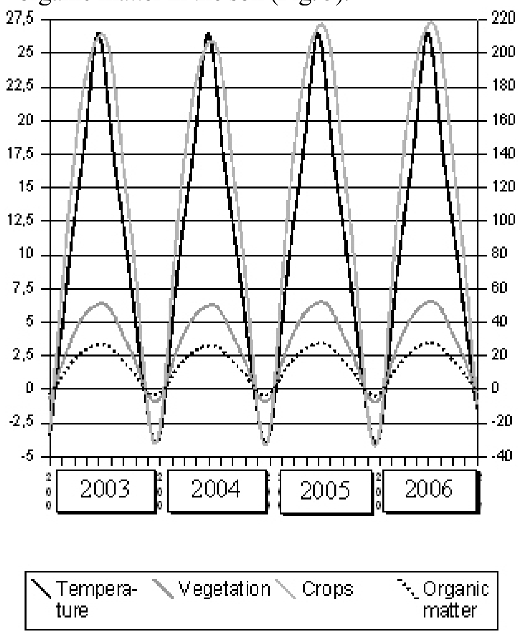

Fig. 5 – The evolution of the soil's organic matter concentration, spontaneous vegetation and crops productivity, in function of the air temperature evolution

4. At the last we analyzed the evolution of the spontaneous vegetation and crops productivity (t/ha/year), in function of the evolution of the storage processes of the organic matter in the soil and vice-versa (Fig. 6).

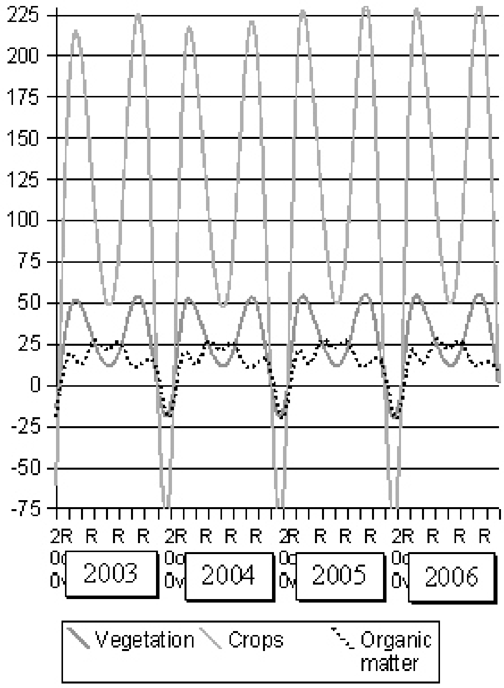

Fig. 6 – The evolution of the soil's organic matter concentration, spontaneous vegetation and crops productivity

Rezumat

Pentru a realiza o procesare matematică a datelor, obținute prin cercetări de teren în cadrul Incintei îndiguite Murighiol-Dunavăț, am optat pentru o utilizarea unei ecuații rezultată prin combinarea ecuației de creştere logistică cu ecuația utilizată la descrierea distribuției lui Gauss.

References

1. LAHERRÈRE J.H., 2000 - *The Hubbert curve: its strengths and weaknesses*. Version proposed to Oil and Gas Journal, http://dieoff.org
2. *** "*Logistic function*". Wikipedia, the free encyclopedia, 2006, http://wikipedia.org/
3. *** "*Normal distribution*". Wikipedia, the free encyclopedia, 2007, http://wikipedia.org/

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 164 – 167

STUDIES REGARDING THE MORPHOGENETIC REACTION OF *HYPERICUM PERFORATUM*L. EXPLANTS TO "IN VITRO" MEDIUM CONDITIONS FOR THE ESTABLISHMENT OF AN EFFICIENT REGENERATION PROTOCOL

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PRISECARU MARIA**

ABSTRACT

CRISTEA T. O., FALTICEANU M., PRISECARU M., 2006 - Studies regarding the morphogenetic reaction of *Hypericum perforatum*L. explants to "in vitro" medium conditions for the establishment of an efficient regeneration protocol.*Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 164-167.

The present study was undertaken for the establishment of the morphogenetic reaction of the explants to different type and concentration of growth hormones added to the basal culture medium. Thus, the investigations were focused toward the achievement of rapid multiplication and improvement of *Hypericum perforatum* (a valuable herbaceous medicinal plant) through plant regeneration from tips. The explants excised from healthy mother plants were cultured on Murashige-Skoog, 1962 medium supplemented with KIN, NAA, IAA, BAP and GA_3 individually and in various combinations. Best shoot induction was noted on medium with BAP and NAA. In general, NAA alone promoted root induction at all the regenerated shoots. Rooted shoots were successfully re-established in soil under controlled conditions.

Key words: micropropagation, vitro, *Hypericum prforatum* L.

Introduction

Micropropagation is used routinely to generate a large number of high-quality clonal agricultural plants, including ornamental, medicinal and vegetable species. Micropropagation has significant advantages over traditional clonal propagation techniques. These include the potential of combining rapid large-scale propagation of new genotypes, the use of small amounts of original germplasm (particularly at the early breeding and/or transformation stage, when only a few plants are available), and the generation of pathogen-free propagules.

Each specie respond differently to „in vitro" conditions. There is a range of morphogenetic respons that starts from the total lack of answer („recalcitrant species") to a large number of somaclones that can be easily regenerated from small parts of the mother plants.

An extremely important issue is the establishment of the hormones regulators and environmental conditions that can lead to the dedifferentiation of the initial tissue and to the reorientation of the developmental and growth processes.

The aim of the present study is exactly the establishment of the best hormonal balance and environmental conditions for the establishment of a rapid and efficient micropropagation protocol.

Material and methods

The explants were collected from valuable mother plants maintained at Vegetable Research Station Bacau in controlled conditions. Young shoots of 1.5 -2 cm length were excised from actively growing plants.

The defoliated shoots were first washed in tap water and the sterilized in 0.1% HgCl2 for 15 minutes, and 3 rinses in sterile distilled water.

The shoots were then utilized as donor source for explants. The apexes of ~ 1,5 cm were excised and inoculated on Murashige -Skoog, 1962 culture basal medium supplemented with KIN, NAA, IAA, BAP and GA_3 individually and in various combinations (table 1). To all these variants 30 g/l sucrose and 8 g/l agar were added. The pH of the medium was established at 5,8 before the autoclavation at 121^0C for 25 minutes.

Cultures were incubated at 24±1°C under 16 hr photoperiod of 3000-lux light intensity.

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The cultures were transferred at a 3 weeks interval on fresh media, for a period of 90 days.

Observation of shoot multiplication and growth were recorded at weekly intervals. After three weeks, shoots of above 3 cm length were harvested and subcultured on the same medium containing lower concentrations of BAP and NAA – 1,5 mg/l, respectively 0,5 mg/l.

Tab.1 - Variants of nutritive medium with different hormonal factors utilized for "in vitro" regeneration

Variant	BAP	KIN	NAA	IAA	GA_3
H_0		-	-	-	-
H_1	-	5.0	1.0	-	-
H_2	-	3.0	-	2.0	-
H_3	-	2.0	-	0.1	-
H_4	-	3.0	-	-	-
H_5	5.0	-	-	2.0	-
H_6	5.0	-	-	-	0.1
H_7	3.0	-	-	1.5	-
H_8	3.0	-	1.5	-	-
H_9	2.0	-	-	1.0	-
H_{10}	1.5	-	1.0	-	-
H_{11}	1.5	-	0.5	-	-

A part of the newly formed shoots that demonstrated a good development of leafs were transferred to rooting medium containing different concentration of NAA (Tab. 2).

Tab. 2

Components	R_1	R_2	R_3
Macroelements	MS	MS	MS
Microelements	MS	MS	MS
Vitamins	MS	MS	MS
NAA	0,6	0,8	1
Sucrose	30 g/l	30 g/l	30g/l
Agar	8 g/l	8 g/l	8g/l
pH	5,8	5,8	5,8

After 2 weeks, the rooted plants were acclimatized and planted in a potting mixture of sterilized sand + vermiculite (1:1 ratio) in plastic cups, hardened in a mist chamber (80% relative humidity) for 2 weeks before transfer to a green house.

Results and discussions

The initiation of regenerative processes were accomplished at 6 days after the explant`s inoculation on the aseptic nutritive medium. First, 1 or 2 small buds were observed, and then the evolution was positive - in almost two weeks, 9 shoots were developed on the initial explant of only 1.5 – 2.0 cm long.

Fig. 1 - Tips at the beginning of their evolution

Not all the inoculated explants had the same morphogenetic reaction, due to the fact that there are functional differences between the similar morphologic explants. In this stage of ontogenetic development there are different particularities in the organogenesis reaction of the explant, particularities that lies on the specific totipotence of each explant (table 3). On the other hand, a part of the tips were eliminated due to their gradual degeneration (reaching to necrosis), or to the secondary contamination of the recipients. The morphogenetic reaction of the *Hypericum perforatum* explants was favorable, the initiation and development of the regenerative structures were followed by the rapid development of the neopropagules.

Fig. 2 - General aspects of micropropagation

The obtained results demonstrate the fact that the initiation of the regenerative processes at the explant level is directly influenced by the exogenous growth regulators. This fact is underlined by the results that were obtained on the witness variant, H_0, variant characterized through the absence of any growth regulators. The percentage obtained on this variant was only 33%, when comparing with the variant H_{11} and H_8, where the percentage was higher – 93% (both characterized through the presence of hormones BAP and NAA).

Tab. 3 - The frequency of the "in vitro" morphogenetic reaction of *Hypericum perforatum* L. explants on the cultivation medium

Variant	No. inoculated explants /variant	No. of reactive explants	
		Explant	Freq.%
H_0	15	5	33%
H_1	15	9	66%
H_2	15	7	46%
H_3	15	8	53%
H_4	15	8	53%
H_5	15	10	67%
H_6	15	9	66%
H_7	15	11	73%
H_8	15	14	93%
H_9	15	12	80%
H_{10}	15	13	86%
H_{11}	15	14	93%

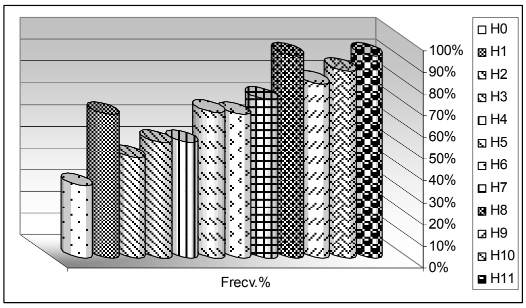

Fig. 3 - The "in vitro" morphogenetic reaction of *Hypericum perforatum* L. explants on the cultivation medium

As the dates from table 1 and figure 3 shows, the best morphogenetic reaction was obtained on the variants with BAP and NAA. The values obtained on these variants (H_8, H_{10}, H_{11}), were net superior to the one obtained on the variants in which the BAP was replaced by kinetine or in those one in which the NAA was replaced with IAA. The addition of GA3 does not favorable influence the regeneration process, contrary, on these variants the incidence of vitrification processes was even higher.

The kinetine, one of the citokinins that in generally, promotes the development of the adventive shoots at a large number of species, proved to be inefficient in the condition tested in the present study. The values obtained on these variants were between 46 - 66% (variants H_1 – H_4).

The shoots regeneration was accomplished through the neoformation of adventive shoots (at the basis of the inoculated tips) as well as through the multiple axillary sprouting (through the development of pre-existent meristematic centers).

A part of the regenerated sprouts were cultivated on fresh cultivation mediums in order to continue the regenerative processes. Gradually the shoots that were at the best stage of development were inoculated on rooting medium, which should allow the initiation and development of roots. The reaction of the shoots on the tested mediums is schematically presented in table 3 and figure 5.

Tab. 3 - The "in vitro" morphogenetic reaction of *Hypericum perforatum* L. shoots on the rooting medium.

Variant	No. of inoculated shoots	No. of rooted shoots	% rooting
R_1	41	37	90%
R_2	56	48	86%
R_3	65	55	85%

Fig. 4 - Shoots on rooting medium

The highest rooting ratio was obtained on R1 variant, in which the amount of NAA hormone was of 0.6 mg/l. The increase in the auxine quantity was not related with an increase in the rooted shoots, but, the values wee even smaller when the concentration increased.

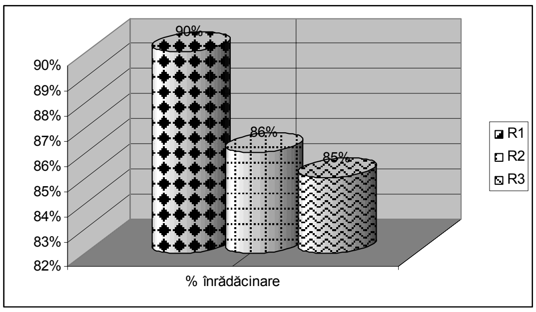

Fig. 5 - The "in vitro" morphogenetic reaction of *Hypericum perforatum* L. shoots on the rooting medium

10 - 12 days after the inoculation of the shoots on the rooting mediums, the plants were transferred on hydroponics medium and kept about four days covered with a plastic foil, in the culture room. Subsequently, they were day by day acclimatized to room atmosphere.

Surviving plants, nearly 90-92%, were transferred to the greenhouse and grown to maturation.

Conclusions

The results of the present study demonstrated the fact that *Hypericum perforatum* is a specie suitable for cultivation in „in vitro" conditions, the morphogenetic reaction of the explants being positive – with the initiation and development of the regenerative structures were followed by the rapid development of the neopropagules.

In the experimental conditions tested in the present study, the tips, utilized as initial explant, allowed the regeneration of uniform and stable plants.

The best morphogenetic reaction was obtained on the variants that contained as growth regulators BAP and NAA. The values obtained on these variants ($H_{8,}$ H_{10}, H_{11}), were net superior to the one obtained on the variants in which the BAP was replaced by kinetine or in those one in which the NAA was replaced with IAA.

The shoots regeneration was accomplished through the neoformation of adventive shoots (at the basis of the inoculated tips) as well as through the multiple axillary sprouting (through the development of pre-existent meristematic centers).

The highest rooting ratio was obtained on R1 variant, in which the amount of NAA hormone was of 0.6 mg/l. The increase in the auxine quantity was not related with an increase in the rooted shoots, but, the values wee even smaller when the concentration increased.

The obtained experimental results encourage the continuation of the researches for the determination of all the factors that can influence the regeneration process (genotype, explant, etc). This should allow the establishment of a rapid and efficient propagation technology that permit the regeneration of a large number of plants, in short term, plants that have the same genetic background as the parental plants.

References

1. COOKE T.J., RACUSEN R.H., COHEN, J.D., 1993 - *The role of auxin in plant embryogenesis.* The Plant Cell, 5: 1494-1495.
2. ERNST D., OESTERHELT D., SCHÄFER, W., 1984 - *Endogenous cytokinins during embryogenesis in an anise cell culture (Pimpinella anisum L.).* Planta, 161:240-245.
3. JOHN BRITTO, S., J. JOHN ROBINSON, NATARAJAN E., AROCKIASAMY D.I., 2001 - *Micropropagation of Hyptis suaveolens (L.) Poit. (Labiatae) through nodal culture.* Adv. Pl. Sci. 14:561-565.
4. JOHN BRITTO, S., KRISHNAVENI S., NATARAJAN E. AROCKIASAMY D. I., 2001- *Clonal propagation of Anisomeles indica L. from nodal explants.* Pl. Tiss. Cult. 11: 93-96.
5. KOMALAVALLI, N., RAO M. V., 1997- *In vitro micropropagation of Gymnema elegans Wt.&Arn.-A rare medicinal plant*. J. Exp. Biol. 35: 1088-1092.
6. MURASHIGE T., SKOOG F., 1962- *A revised medium for rapid growth andbioassays with tobacco tissue cultures.* Physiologia Plantarum, 15:473-497.
7. SUDHA G. C., KRISHNAN P. N., SEENI S., PUSHPAGANDAN P., 2000- *Regeneration of plants from in vitro root segments of Holostemma annulare (Roxb.) K. Schum., a rare medicinal plant*. Curr. Sci. 78: 503-506.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE MORPHOLOGICAL INDEX OF CARACTERIZATION OF CHROMOSOMES AND THE KARYOTYPE OF *CAPSICUM ANNUUM* L., SPECIES

ELENA CRISTINA ROŞU,
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ABSTRACT

ROŞU E. C., BĂRA I.I., 2006 – The morphological index of caracterization of chromosomes and the karyotype of *Capsicum annuum* L., species. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 168-169.

This paper present the morphological index of the caracterization of the chromosomes at Capsicum annuum L. species, grossum convariety, Export variety. The species has an chromosomes number 22 = 245, clasified in two morphological types (medians and submedians), with relatively little length. The karyotype is uniformly, simmetricaly and weak (some) advanced.

Key words: chromosomes, karyotype, cytogenetic, *Capsicum*

Introduction

The chromosomes number is a character of the species, and the study of chromosomial complement is a sure argument in establishing the ways wich the species advanced had going, the variety of genetics material and in the same time give the sure informations about the kinship degree of the differently species.

The study of chromosomes morphology and the karyotypes comparison of species at one genre at wich were adds the fenotipical studys, had an important role in establishing of the kinship degree and the evolution at one genre.

The *Capsicum* genre, is an important genre in Solanaceae family, including more than 245 species, initial in Central America. The pepper Export variety, is an variety cultivated in Romania, some precociosusness is an early variety, of yelow-green coulour for consume and red colour at fiziological maturity, the fruit wight is 80-120g and an potential 35-40t/ha.

Material and methods

The best stage of division for the karyotype analyse, is the mitotic methaphase, when the chromosomes send in maximum of the condensation and of color.

For the study of the chromosomes had been used the peper seeds Export variety, wich germinated on paper filter , in disilled water in Petri box at 23-240C. When the roots had about 1 cm length, had been prefixed in to the colchicine solution 0.2%, 2 houres. After the prefixion , the seeds had been washing with disilled water and immersed in Battaglia fixing 24 houres. After the prefixing the seeds had been preservable in alcohol 70%.

For the examination at microscope, the seeds had been hydrolyzed with HCl 1N 5 minutes and with HCl 50% 8 minutes. The roots had been coloured with Carr solution 24 houres.

Rezults and discussions

For grouping the chromosomes in pairs has been used the nomenclature by position of the centromere after A. Levan and colab. 1964, Raicu P., 1969.

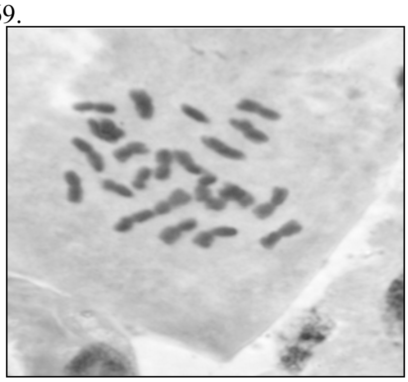

Fig.1 - The methaphase for the karyotype

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The pair of chrs.	The type of chrs.	Long arm (µm)	Short arm (µm)	Arms ratio (LA/SA) (µm)	Total lenght (µm)	Centromeric index
I	m	2.81	2.29	1.22	5.22	43.86
II	m	2.38	2.24	1.05	4.83	46.46
III	m	2.48	2.12	1.16	4.74	44.82
IV	m	2.38	2.18	1.08	4.67	46.80
V	m	2.35	2.12	1.10	4.55	46.72
VI	m	2.23	2.09	1.06	4.50	46.53
VII	m	2.33	1.88	1.23	4.25	44.38
VIII	m	2.15	2.06	1.04	4.18	49.46
IX	m	2.33	1.62	1.44	4.07	39.76
X	m	2.24	1.60	1.42	3.91	41.43
XI	m	2.20	1.36	1.60	3.75	36.56
XII	Sm	1.96	1.13	1.73	3.12	36.19

Fig.2 - The morphological index of caracterization of the chromosomes of *Capsicum annuum* L., species (2n = 24)

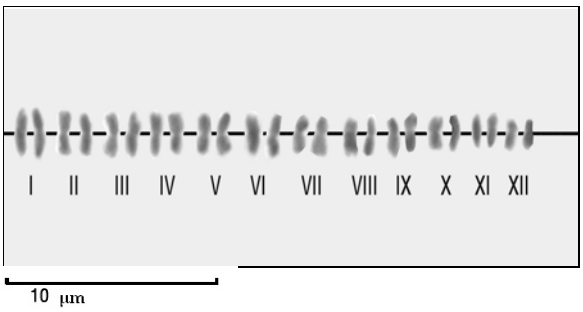

Fig.3 - The karyotype of *Capsicum annuum* L., convar. *grossum*, *Export* variety

For grouping the chromosomes in pairs has been used the nomenclature by position of the centromere after A. Levan and colab. 1964, Raicu P., 1969).

After the research on metaphases for karyotipe, we can confirm diploidy of the species and the number of chromosomes 2n = 24.

The total longueurs of chromosomes is relatival small, betwin 5.22µm and 3.12 µm.

After of the morphological criterion, has been found two morphological types of the chromosomes: medians (11 pairs) and submedians (1 pair).

In the medians group, are included the chromosomes from the pairs I, II, III, IV, V, VI, VII, VIII, IX, X and XI, with the longueurs intercensal in the 3.75-5.22µm and with the report of the arms 1.04-1.62µm.

In the submedians group, is included the pair XII of the chromosomes, with the length 3.12µm and with the report of the arms 1.73µm.

The karyotipe of this species is evenly, without many morphologycal groups of chromosomes which evidential the symmetry of this karyotype.

As for Stebbins (1974-*Flowering plants*), the symmetry of the karyotype implies an feeble evolution. An advanced karyotype, is a karyotype, with an reduced number of chromosomes and asymmetrical, so that according to this and with ours studyes, the species has an symmetrical karyotype and some advanced even primitive.

Keeping with the specialty literature, the *Capsicum* genus, has two chromosomial number of base x = 12 and x = 13 (rare at domesticale species). As well, there is an great variability of the morphological types of the chromosomes at the species of the genus *Capsicum*. This explained through the existence of the noumerouses natural chromosomial reorganizations in this genus (Pickersgill, 1977).

There is some species of the *Capsicum* wich have the satellites, this evidential of the intraspecific variability of the caryotype in this genus.

Conclusions

The study of the chromosomes at *Capsicum annuum* L., convariety grossum, Export variety, to emphasis the presence of the number of chromosomes 2n = 24, an symmetrical karyotype, not so advanced, with two morphological types of chromosomes, medians and submedians. In our methaphases, the karyotype, we didn't find the chromosomes with satellites.

Rezumat

Lucrarea prezintă indicii morfologici de caracterizare a cromosomilor la specia *Capsicum annuum* L., convarietatea *grossum*, soiul *Export*. Specia are un număr de cromosomi 2n=24, grupați în două tipuri morfologice (mediani, şi submediani), cu lungimi relativ mici. Cariotipul este unul uniform, simetric şi puțin evoluat.

References

1. ANDRONICESCU D., ANGHELESCU H., 1968 – *Ardeiul*. Edit. Agro-Silvică, Bucureşti, pag. 3-44, 116-128;
2. CÂMPEANU M. M., MANIU M., SURUGIU I., 2002 – *Genetica – metode de studiu*. Ed. Corson, Iaşi, pag. 26-34, 68-78;
3. EDUARDO A. MOSCONE, 1990 – *Chromosomes studies on Capsicum L., karyotipe analysis in Capsicum coënse*. Brittonia, vol. 42, No-2, pag. 147-154;

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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EFFECT OF POLLUTION WITH CEMENT DUST UPON SUPEROXID – DISMUTASE ACTIVITY AT DIFFERENT PLANT SPECIES

CRĂIŢA – MARIA ROŞU*, ŞTEFANIA SURDU*
ZENOVIA OLTEANU**

ABSTRACT

ROŞU C. M., SURDU ŞT., OLTEANU Z., 2006 – Effect of pollution with cement dust upon superoxid-dismutase activity at different plant species. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 170-173.

In the present study was monitorized the dinamic of superoxid - dismutase activity (SOD) in some plant species from spontaneous vegetation, harvested from area with different polution degree with cement dust, proving the importance of these enyzme in assuring of plant tolerance to the xenobiotic stress.

Key words: superoxid – dismutase (SOD) activity, spontaneous flora, cement dust pollution.

Introduction

Reactive oxygen species (ROS): superoxid radical (O_2^-), hydrogen peroxide (H_20_2) and hydroxyl radical (OH^-), are present in all aerobic organisms. In unstressed plant cells these reactive forms are generated, usually, at low level (in chloroplasts and mitochondria or by citoplasmic enzymes implied in redox reaction). In case of abiotic stress of plants, ROS are eliberated fast and in large quantity, as a result of secvential reduction of molecular oxygen (O_2). Opposite to the oxygen, the reactive oxygen species are very reactive and toxic compounds, witch induce oxidative deteriorations of cells.

The improvement of the organisms defense systems against ROS and also, the last information about their role, demonstrate a dual character, this compounds being toxic products of aerobic metabolism, but, also, being the key regulators of metabolism pathway and defence.

The ROS level in different subcellular compartments is determinate by various ROS producing pathway and by implication of removing mechanisms of them.

Besides of ROS aerobic methabolism producing pathway (photosynthesis and respiration) there is and another sources witch are being represented by the pathway witch intensify their activity after abiotic stress (photorespiration).

In order to minimize disorders induced at celullar level by these free radicals, in plant is acting an endogenous anti-oxidative defense system. Thus, the plant protection against these free radicals depends on the efficiency of this endogenous defense system.

Material and methods

Biological material: the plants (*Trifolium pratense, Lotus corniculatus, Plantago lanceolata, Plantago major, Fagus silvatica, Populus tremula, Abies alba, Picea abies, Crataegus monogyna, Salix fragilis*) were harvested in three different stadia, during the vegetation period, from different aria regarding the grade of pollution with cement dust, witch are coming from CARPACEMENT FACTORY – NEAMT, as follows: I.- Potoci (control – unpolluted plants), II. -Tasca, III – Carpatcement Tasca, IV.- Carpacement loading point.

Enzymatic assay: superoxid-dismutase activity was assayed in leaves by spectrophotometric method (Winterbourn C. and col., 1975).

Results and discussion

Our investigations has showed that superoxid dismutase activity has recorded an intensification in the first two harvesting stadia (7.06.2006 and 13.07.2006), when the plants are in the conditions of active vegetation, and the reaction toward xenobiotics factors is faster. Also, in many plants, excepted woody species, this intensification is positive correlate with pollution degree. Thus, at *Trifolium pratense and Plantago lanceolata* harvested from areas with highest pollution degree, at 7.06.2006, the SOD activity has recorded 94,88% and 71,2% inhibition (Carpatcement Tasca), comparing with 77,45% and, respectively, 66,89% inhibition (Potoci - control)(Fig. 1 and 3).

The same behavior was registered in samples (*Trifolium pretense, Plantago lanceolata and Plantago media* plants) harvested at 13.07.2006, where the highest activity (89,77% inhibition) was recorded in leaves from Carpatcement loading point (IV), comparing with 67,92 % inhibition, in plants harvested from less polluted area (Carpatcement Tasca).

Lotus corniculatus plants doesn't respond in the same way to the pollution factor, the level of superoxid-dismutase activity in leaves from Carpatcement Tasca (III) polluted area being more reduced (36,20% inhibition – 7.06.2006 and 54,60% inhibition -13.07.2006) comparing with registered values in control plants (Potoci area), as follows: 57,80% inhibition (7.06.2006) and 81,80% inhibition (13.07.2006) (Fig. 2).

In the case of woody plants, the lowest SOD activity has been recorded in *Crataegus monogyna* plants, with 61,30% inhibition in leaves with highest pollution level (Carpatcement loading point) towards 88,37% inhibition in control plants (Potoci area) (Fig. 4).

The scope of superoxid – dismutase (SOD) assay in these experiments, was generated by knowledge of implication of these enzyme in defense mechanisms of plants towards structural and functional degenerations of cell membranes under free radicals actions, first generated being O_2.

Otherwise, because activated oxygen is necessary to detoxify xenobiotic chemicals, in plant cells is absolutely necessary maintaining of a balance between oxygen free radicals reactivity level and antioxidant enzymatic system activity level, under pollution stress condition.

Maintenance of this balance is critical in order to keep an active development and normal metabolism of plants and, also, in assuring a good tolerance to environmental stress.

In these conditions, it's considered that SOD activity intensification at *T. pratense, P. lanceolata* and *P. media* species, harvested from polluted area (Carpatcement Tasca and Carpatcement loading point) signify a rapid reaction of plants to oxidative stress and could be considered, from this point of view, like tolerants to pollutants actions.

The phenomenon of decreasing of SOD activity at *Lotus corniculatus* plants and, also, at woody species tested, more intense in *Crataegus monogyna* plants, could signify only a sensitivity of these species to pollutant factor by inhibition of normal respiration and photosynthesis mechanisms in leaves.

Conclusions

- SOD activity has been increased in plant cells like response to xenobiotic stress, it's activity being regulated depends on oxidative stress intensity.
- A higher SOD activity at *T. pratense, P. lanceolata* and *P. media* species, harvested from high polluted area (Carpatcement Tasca and Carpatcement loading point) signify a faster reaction of plants to oxidative stress, witch could be considered like tolerants to the pollutants reaction.
- In very high pollution conditions the cement dust can cause chlorosis and cell death, but this fact was not noticed in our experiments, even in high pollluted plants situations.

Rezumat

In studiul de față s-a urmărit dinamica activității superoxid-dismutazei (SOD) la diferite specii de plante din flora spontană, provenită din zone cu diferite grade de poluare cu praf de ciment, demonstrându-se rolul acestei enzime în asigurarea toleranței plantelor la stresul cu substanțe xenobiotice.

References

1. FRIDOVICH I.,1986 - *Biological effects of the superoxide radical*. Arch Biochem Biophys 247, 1
2. WINTERBOURN C., HAWKINS R., BRIAN M., CAREL, R., 1975 – *The estimation of the red cell superoxide – dismutase activity*. J.Lab. Clin. Med., 85: 337.

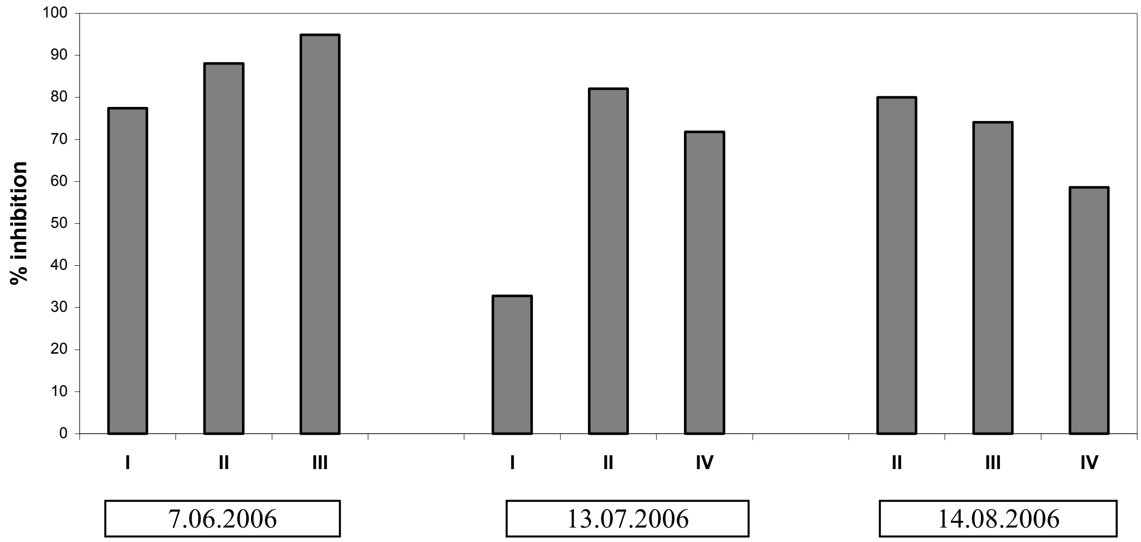

Fig. 1 – Superoxid – dismutase activity (SOD) at *Trifolium pratense* plants, harvested from area with different pollution degree (I – Potoci, II – Tasca, III –Carpatcement Tasca, IV – Carpatcement loaded point)

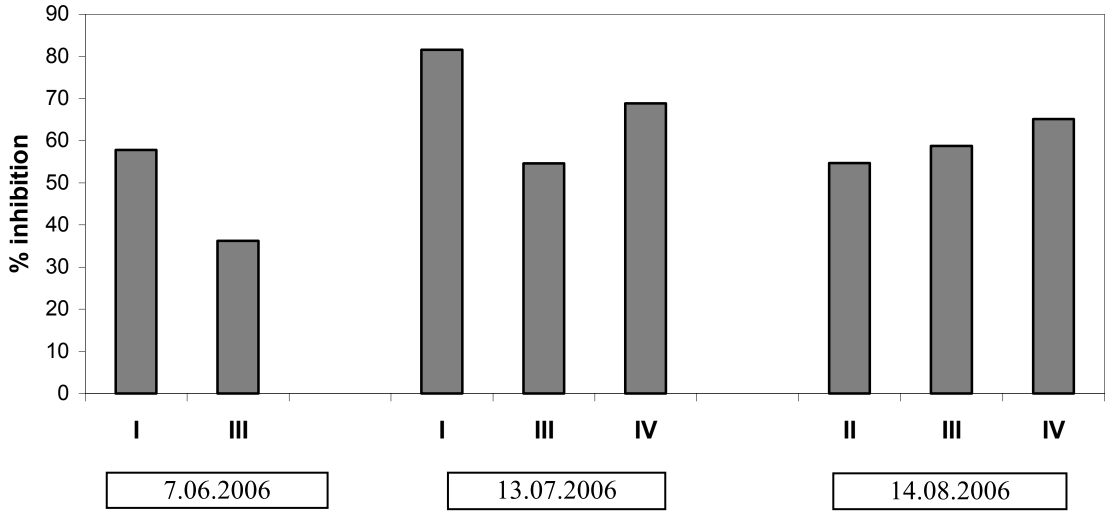

Fig. 2 - Superoxid – dismutase activity (SOD) at *Lotus corniculatus* plants harvested from area with different pollution degree (I – Potoci, II – Tasca, III – Carpatcement Tasca, IV – Carpatcement loaded point)

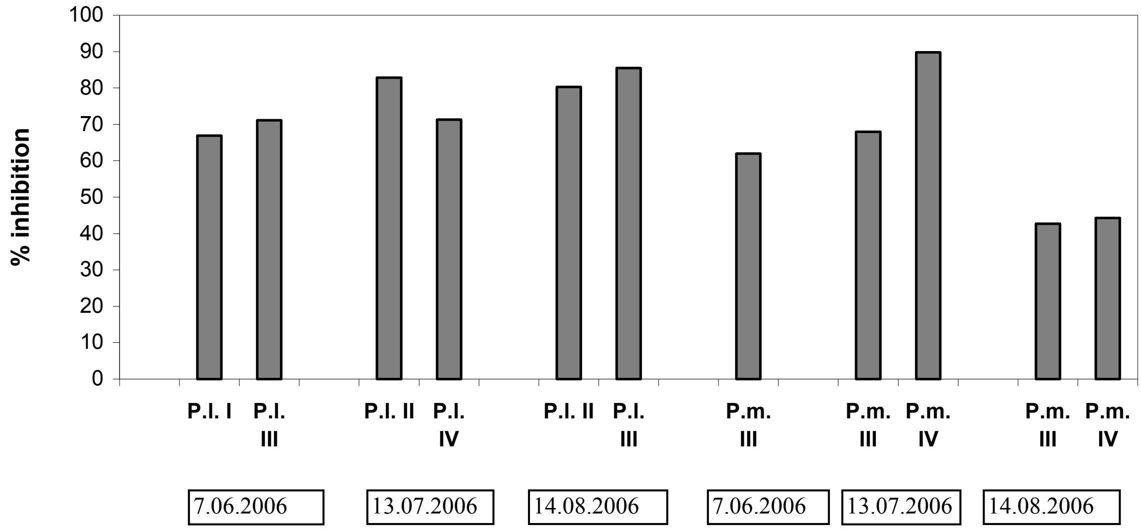

Fig. 3 – Superoxid – dismutase activity (SOD) at *Plantago lanceolata* (P.l.) and *Plantago major* (P.m.) plants, harvested from area with different pollution degree
(I – Potoci, II – Tasca, III –Carpatcement Tasca, IV – Carpatcement loaded point)

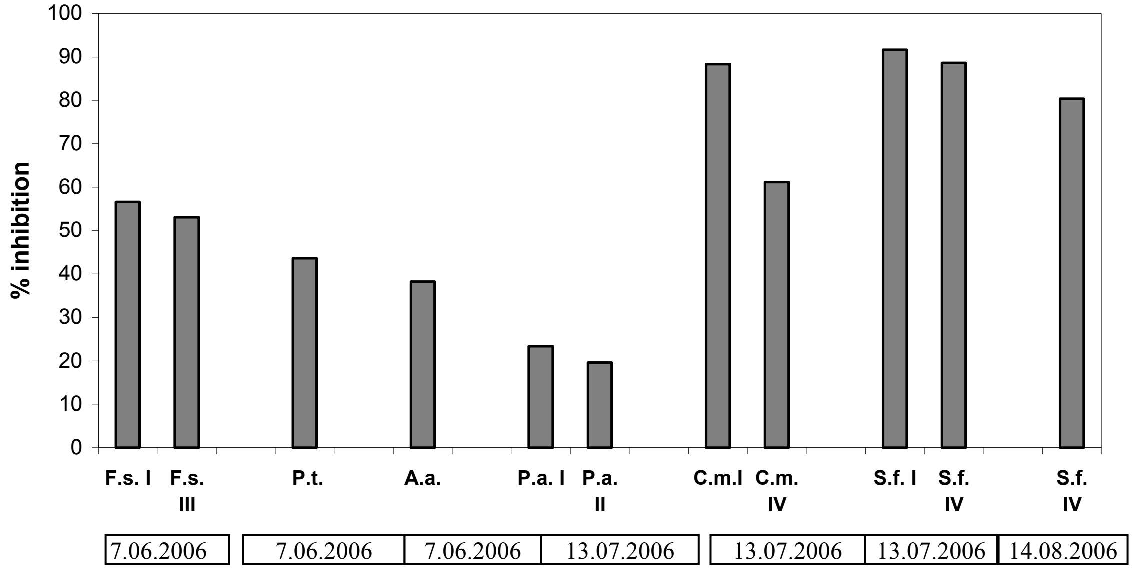

Fig. 4 – Superoxid – dismutase activity (SOD) at *Fagus silvatica* (Fs I, III.),
Populus tremula (Pt), *Abies alba* (Aa), *Picea abies* (Pa),*Crataegus monogyna* (Cm), *Salix fragilis* (Sf) plants, harvested from area with different pollution degree (I – Potoci, II – Tasca, III –Carpatcement Tasca, IV – Carpatcement loaded point)

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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ECOPHYSIOLOGICAL STUDIES AT DOMINANT SPECIES IN SOME GRASSLAND ECOSYSTEMS FROM MOLDAVIAN PLAIN

LIGIA ACATRINEI*

ABSTRACT

ACATRINEI L., 2006 – Ecophysiological studies at dominant species in some grassland ecosystems from Moldavian plain. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 174-176.

Ecophysiological analyses were made in dominant species in natural prairies. It were pursued some ecophysiological indicators as photoassimilatory pigments, quantity of sugars and protein content in leaves of species from different grassland (mezo-, xerophilous and wet-salted) at Moldavian Plain.

Key words: grasslands, proteins, sugars, photassimilatory pigments

Introduction

It was known in literature as Jijia Depression, this subunit are situated in nord-eastern of Moldavian Plateau between Prut valley (in east and north), and Barlad plateau in south to the alignment of localities of Tomeşti, Ciurea, Voineşti, Horleşti. Vegetation is represented by the oak forest, pasture and hayfield, the rest is occupied by the crops, Moldavian Plain is including, in general, in sylvosteppe region.

Material and methods

The biologic material was collected from 6 stations which are the natural prairies. These ecosystems are mezo- and xerophilous prairies. The stations are: Sărata, Vulturi (costal and xerophilous prairie), Deleni and Horleşti(grazing prairies), Uricani(wet and salted prairie) in comparison with Valea lui David (control) that are xerophilous prairie.

The fresh leaves as biological material were collected in May and June when the phenophase of blossom was onset and physiological parameters are at the great concentrations. It was analyzed: the leaves content in photoassimilatory pigments (chlorophyll a, chlorophyll b, carotenoids) and sugar quantity. The photoassimilatory pigments were determined by the solvation in acetone solution 85 % of the fresh leaves. The sugars dosing in dry material were made by combined Bertrand with Borel method. Proteins content was determined through Lowry method. The results were expressed in mg/g fresh weight.

Results and discussions

1. Photoassimilatory leaves content

Analysis of **chlorophyll a** has shown a variation of this parameter between 0.40 mg/g fr.w (*Juncus gerardi, Plantago schwarzenbergiana*-Uricani station) until 1 mg/g fr.w (*Adonis vernalis, Vinca herbacea*-Sărata and Vulturi stations), as is presented in table 1. The great values were registered in all leaves species at Sărata station and the smallest were registered in leaves species at Uricani and *Veronica chamedrys* at Horleşti station.

Chlorophyll b was registered the variation between 0.084 mg/g fr.w(*Potentilla arenaria*-Deleni station) until 0.3 mg/g fr.w (*Vinca herbacea*-Vulturi station, *Adonis vernalis*-Sărata, and also, Vulturi station). The great values were observed in two of dominant species at Sărata and Vulturi stations and the smallest in *Potentilla arenaria* at Deleni station. Lower values which are having the mean of 0.14 mg/g fr.w were registered in all leaves species of Uricani station, comparatively with control.

Carotenoids pigments varied between 0.114 (*Juncus gerardi, Plantago schwarzenbergiana*-Uricani station) until 0.414 mg/g fr.w(*Adonis vernalis*-Sărata station). The lowest values, comparative with control have been registered in species of Uricani station.

Total quantity of pigments had a register of variation between 0.6 mg/g fr.w (*Juncus gerardi, Plantago scwarzenbergiana, Stemmacantha serratuloides* - Uricani station) until 1.8 mg/g fr.w (*Adonis vernalis*-Sărata station).

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Chlorophyll a/chlorophyll b rapport (a/b) are placed between 2.5 until 6. The greatest values are observed in species of Deleni station (*Potentilla arenaria*-6.14; *Nonea pulla*-4.36), rest of the interval has the values around 3 that are closed with control.

Chlorophylls/carotenoids rapport (a+b/c)
It had the limits to 4.98 until 2.75. The values of dominant species (4.3 in average) at Uricani Station are the closest to the control which is 4.9, followed by the values species of the Vulturi station (4.2 in average).

The lowest variation of these analyzed rapports it are observed in species of Vulturi, Sărata, Uricani and Horleşti Stations. Analyzed rapports of the species from the investigated stations have very little variation that demonstrates o good adaptability and stability to the biotope conditions (2, 4).

2. Quantity of sugars
Sugars biosynthesis are analyzed on the soluble forms: monosaccharides and disaccharides in leaves of dominant plants. On June, the majority of the dominant species are represented by the graminaceae. Perennial grass plants have the great dominance on grassland; they could remaking the vegetative mass after cutting and support well the summer drought grace to roots system and to the existing reserve at young shoots. As it could be observing in table 2, **monosaccharides** in dominant grass leave have a variation between 3.29-1.6 %. The higher values of sugars were registered in following species: *Agropyron repens* (Uricani station) and *Dactylis glomerata(*Valea lui David), both having 3.18 g % and also, *Dactylis glomerata* in Horleşti station has 3 g %. The lower values were registered in species *Stipa joannis*(1.6 g %) and *Stipa lessingiana* (1.78 g %-Sărata station).
Disaccharides are placed in a register of variation to 3.4 g % until 6.5 g %. The greatest values are observed in species *Dactylis glomerata*(6.63 g %)-Valea lui David station and respectively, 6.25 g %in Horleşti station. The 6.85 g % which represents the highest value are obtained in *Agropyron repens* at Uricani station.

Total quantity of sugars
Interval of variation has been included to 9 g % in *Dactylis glomerata* (Valea lui David si Horleşti) until 5 g % in *Stipa* sp. (Vulturi si Sărata). The interesting aspect is observed in *Agropyron repens* (Uricani Station) that accumulated the great quantity until 10.15 g % of soluble sugars.
In average, the values of total sugars species in Vulturi and Sărata are nearest with those of the control (Valea lui David), followed at last by the ones of Horleşti and Deleni; a special characteristics have the species of Uricani, because of wet and salted biotope.

3. Protein content
Nutritive values of grassland are given by the abundance of the leguminous plants, becoming valuable as productivity and quality when this plants arriving to 20-25 % of total vegetation. Fodder values is given by the proteic content of leguminous than graminaceae that leading to the enriching soil in nitrogen. Protein analyzing in dominant leguminous plants are shown the variation of this parameter between 35-105 mg/g fr. w. (table 2). The higher values are obtained in species *Trifolium montanum* (105.05-90.96 mg/g fr.w.) at Valea lui David and Vulturi stations. Also, a great content has been registered in *Vicia angustifolia* (79.65 mg/g fr.w) at Uricani station. From all analyzed species *Vicia cracca* has had the lower content of protein in leaves. The smallest value of 36.74 mg/g fr.w has been observed in *Vicia cracc*a at Horleşti station.

Conclusion

1. Highest values of the chlorophylls are registered in all species of Sărata and the smallest are registered in species of Uricani.

2. Rapport of chlorophyll a/b and chlorophylls/carotenoids (a+b/c) showed an increased photosynthetic capacity in analyzed species from Vulturi, Sărata and Horleşti stations.

3. Saccharides varied between 9 % in *Dactylis glomerata* decreasing to 5 % in *Stipa*. The interesting aspect of accumulation of sugars until 10.15 % that represented the greatest value occurred in *Agropyron repens* from Uricani station.

4. Protein content in leguminous plants has the higher values in leaves of *Trifolium montanum* (105-90.96 %), the greatest is in analyzed exemplars of Valea lui David, following by the species of Vulturi.

References

1. ANTOHE A., PISICA-DONOSE A., MURARIU A., 1991 - *Cercetări ecofiziologice la gramineele din pajiştile masivului Călimani,* Şt şi Cercet de biologie, ser. Biol. Veget., 2, 43-47.
2. BURZO I., TOMA S., CRĂCIUN C., VOICAN V., DOBRESCU A., DELIAN E., 1999- *Fiziologia plantelor de cultură*. Ed. Ştiința, Chişinău.
3. MURARIU A., 2003- *Fiziologia plantelor din pajişti.* Ed. Junimea. Iaşi.
4. PARIACHI M., 1975- *Solurile de la pol la ecuator, în corelație cu clima şi cu vegetația*. Ed. Stiințifică şi enciclopedică, Bucureşti 1975.

Tab. 1- Variation of the photoassimilatory pigments in leaves of dominant species in natural prairie ecosystems in Moldavian Plain

Station	Species	Chlorophyll a	Chlorophyll b	Carotenoids	Total pigm	a/b	a+b/c
Sărata	*Adonis vernalis*	1.080	0.3374	0.4140	1.8320	3.2024	3.4243
	Vinca herbacea	1.0685	0.2903	0.3979	1.7568	3.6803	3.4147
Deleni	*Potentilla arenaria*	0.5280	0.0864	0.2231	0.8376	6.1064	2.7542
	Nonea pulla	0.9696	0.2220	0.3797	1.5715	4.3663	3.1380
Vulturi	*Adonis vernalis*	0.8239	0.3110	0.2533	1.3882	2.6488	4.4804
	Primula veris	0.6530	0.2458	0.2061	1.105	2.6563	4.3603
	Vinca herbacea	0.9779	0.3601	0.3211	1.6592	2.7156	4.1665
Horlesti	*Veronica chamaedrys*	0.4975	0.1751	0.2131	0.8858	2.8404	3.1556
	Fragaria viridis	0.8072	0.2739	0.2833	1.3645	2.9460	3.8160
Valea lui David	*Crambe tatarica*	0.8265	0.2845	0.2262	1.3373	2.9048	4.9096
Uricani	*Juncus gerardi*	0.4013	0.13624	0.1289	0.666599	2.9460	4.168278
	Stemmacantha serratuloides	0.4149	0.1379	0.1215	0.6744	3.0069	4.5501
	Plantago schwarzenbergiana	0.4098	0.1602	0.1144	0.6845	2.5566	4.9830

Tab. 2 -Variation of the quantities of sugars and protein in dominant species of the natural grassland in Moldavian Plain

Staționar	Specia	Glucide solubile g %	Staționar	Specia	Proteine mg/g subst. proasp.
Sărata	*Stipa lessingiana*	5,4983	**Sărata**	*Medicago lupulina*	62,2327
	Festuca valesiaca	7,0633		*Lotus corniculatus*	40,7008
Deleni	*F. valesiaca*	8,7974	**Deleni**	*Onobrychis viciifolia*	68,5244
				M. lupulina	49,9556
Vulturi	*S. joannis*	5,5829	**Vulturi**	*O. viciifolia*	35,7421
	Dactylis glomerata	**8,0361**		*Vicia cracca*	61,1565
				Trifolium montanum	**90,9674**
Horlești	***Dactylis glomerata***	**9,2542**	**Horlești**	*V. cracca*	36,7402
	Bromus inermis	6,7672			
Valea lui David	***Dactylis glomerata***	**9,8125**	**Valea lui David**	***T. montanum***	**105,0544**
	Stipa joannis	5,0754		*V. cracca*	52,7921
Uricani	***Agropyron repens***	**10,1508**	**Uricani**	*V. angustifolia*	79,6540

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 177 – 183

ON THE ACTIVITY OF TOTAL AMYLASE IN SOME SPECIES OF THE *FESTUCA* GENUS - A COMPARATIVE STUDY

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ABSTRACT

CIORNEA E., COJOCARU D., VASILE G., RĂILEANU T., COJOCARU I. S., 2006 – On the activity of total amylase in some species of the *Festuca* genus – a comparative study. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 177-183.

The study discusses the activity of total amylase in the germinated caryopses of the three species belonging to the *Festuca* genus, namely: *Festuca pratensis*, *Festuca rubra* şi *Festuca drymeia.*

Statistical analysis of the experimental results obtained shows that the enzymatic activity is strongly influenced by the germination time, negligible differences being recorded from one species to another.

Key words: total amylase, germination, graminaceae

Introduction

From immemorial times up to the present days, the period of seeds' germination has been always viewed by all agricultural communities as a "miracle".

Thus, seeds' "awakening" to life, followed by germination, a process through which a new plant, to bear fruit and to produce, in its turn, others seeds, will appear, is still arising a special interest, for both a physiological and a biochemical perspective.

The literature of the field provides numerous information on seed germination and on the other processes accompanying it, yet without fully elucidating the mystery hiding the "miracle" which is however taking place under one's eyes.

From an agronomical perspective, germination may be defined as the process of formation of a healthy plant let from the seed's embryo, which is considered as being completed when the plant becomes autotrophic. Instead, from a physiological perspective, the process is over in the moment in which elongation of the radicle starts, its other stages simply involving growing of both root and stem (BURZO *et al.*, 1999).

Biochemists analyze germination from a metabolic point of view but, as the metabolism of germination consists mainly of the enzymatic degradation of the reserve substances, specialists directed their attention especially on the fascinating complexity of such a mechanism (CIORNEA *et al.*, 2006 a; 2006 b; 2006 c).

The germination process has been studied mainly on culture plants, because of their economic importance, which explains the absence, in the literature of the field, of any data on the dynamics of germination in plants from the spontaneous flora (TĂNASE *et al.*, 2000).

That is why, the authors extended their study on the complex germination of plants belonging tot the spontaneous flora, more precisely on the activity developed by amylases during such processes.

Material and methods

The experiments were developed on germinated caryopses of *Festuca pratensis*, *Festuca rubra* and *Festuca drymeia*, harvested in 2005.

First, the caryopses have been treated with 3% oxygenated water, for the removal of the possible pathogenic germs or of some substances that might have influenced the germination process, and then let to soak for 24 hours. Germination of

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caryopses was made at room temperature, in Petri boxes lined inside with filtering paper wetted with distilled water, samples' taking over being performed at intervals of 24 hours, for 10 days.

The enzymatic activity was determined by the Noelting - Brenfeld method, based on the reduction of the free maltose resulting from the enzymatic hydrolysis of starch, with 3,5-dinitrosalicylic acid, with formation of 3-amino-5-nitrosalicylic acid, orange in color, determined colorimetrically at 540 nm.

As amylase's substrate is the starch, the concentration of this polysaccharide has been evaluated, for each series of samples, by the polarimetric method. Also, for evidencing enzyme's specific activity, proteins' concentration was dosed by the Bradford method (ARTENIE *et al.*, 1981; COJOCARU, 2005).

Results and discussions

A first objective followed in the determination of amylases' activity in the species under study was plotting of the standard curve for converting the extinction units. To this end, a series of reference samples - in which the concentration in maltose varied between 0.2 and 1.8 mg - has been employed. The values of extinction have been read at a wavelength equal to 540 nm (Fig. 1).

On the basis of the graph, the regression straight line has been drawn and its regression equation has been calculated. According to the equation, the amounts of maltose corresponding to the samples subjected to analysis have been subsequently established, and the values obtained were referred to the amount of tissue employed (µM maltose / g).

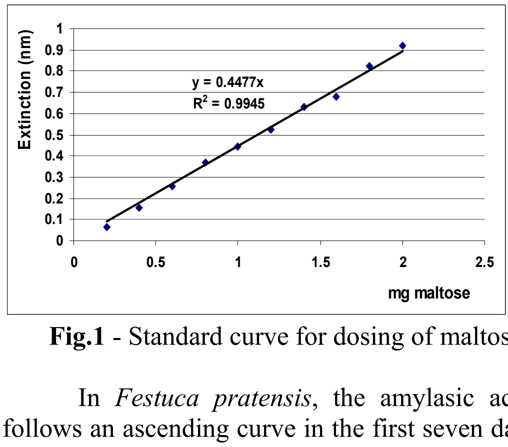

Fig.1 - Standard curve for dosing of maltose

In *Festuca pratensis*, the amylasic activity follows an ascending curve in the first seven days of germination, its maximum being attained in the 7th day (2452.5 µM maltose / g), followed by a decrease up to the last germination day taken into study (640 µM maltose / g) (Fig. 2).

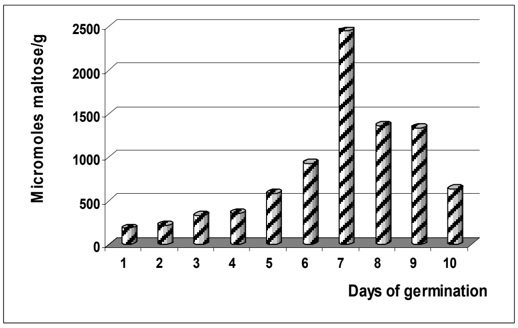

Fig.2 - Dynamics of the absolute activity of total amylase in the germination of *Festuca pratensis* seeds

For a better understanding of the activity of total amylase, its maximum activity has been calculated as percent values (% from the values of maximum activity), followed by its graphical representation (Fig. 3).

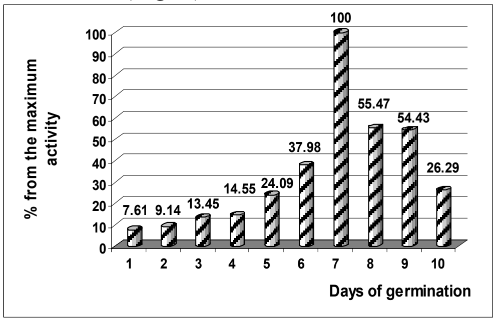

Fig.3 - Dynamics of the relative activity of total amylase in the germination of *Festuca pratensis* seeds

A correlation among the activity of amylase, the amount of starch and protein concentration, along all the ten germination days under analysis for all species taken into study has been established.

The amylasic activity-starch consumption correlation evidences the ever-increasing amount of hydrolyzed starch, which is proportional to the amount of enzyme synthesized in the seeds under germination.

Thus, in *Festuca pratensis*, in the first germination day, when the enzymatic activity is the lowest, the amount of hydrolyzed starch is also minimum. Further on, increase of the amylasic activity is reflected in a higher amount of hydrolyzed starch (causing lowering of starch concentration in the seeds under germination), the maximum being attained in the 7th day, when the amylasic activity is maximum and, although starting to decrease, the amount of hydrolyzed starch still increases.

In the 1st day of the experiment, the concentration of starch is of 65.4 mg%, following a descending curve over the whole ten day period, so that in the last day taken into study it attains a value of 10.7 mg% (Fig.4).

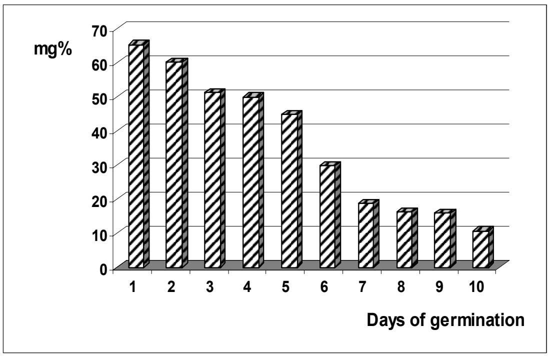

Fig.4 - Starch concentration in germinated seeds of *Festuca pratensis*

The concentration of starch continues to decrease, proportional to the increase of the enzymatic activity and, in spite of the fact that, after attaining a maximum, the amylasic activity records an ever higher decrease, the starch concentration goes on decreasing, although more and more slowly, simultaneously with the decrease registered in the activity of total amylase (Fig. 5).

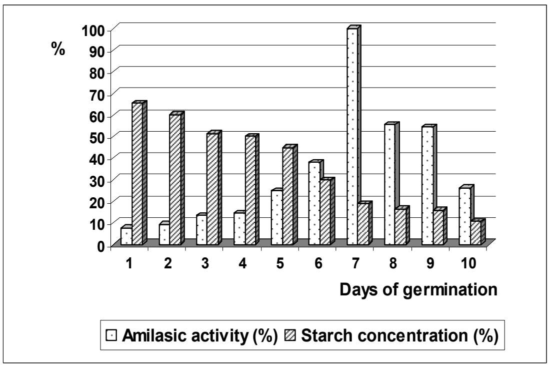

Fig.5 - Comparative representation of starch concentration and enzymatic activity in germinated seeds of *Festuca pratensis*

For the calculating the specific activity, the concentration of proteins in the germinated caryopses of the three species under study has been also determined.

As evidenced by the graphical representation, if, in the first three days of the experiment, the amount of protein decreased, an increase is to be noticed starting from the 4th up to the 7th day, which coincides with the maximum of the enzymatic activity, after which protein concentration in the germinated caryopses starts to decrease (Fig. 6).

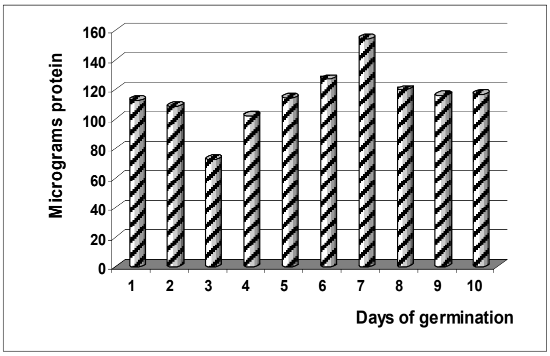

Fig.6 - Dynamics of protein concentration in *Festuca pratensis*

A possible explanation for the increase of the proteins' content is that α-amylase is not present in seeds prior to their germination, the substance being synthesized in seeds' endosperm, during the germination process; on the other side, although β-amylase occurs in seeds in an inactive state, it is synthesized during seeds' germination. As to the decrease of protein concentration after its maximum threshold was attained, it might be explained by the reduction of the amount of starch in seed's endosperm, and by the hydrolysis of the reserve protein substances. In spite of the fact that, in this type of starchy seeds, the predominant reserve substances is the starch, still other additional sources of energy exist, usually employed when the main source is exhausted (NEAMȚU, 1981; BODEA, 1984).

When taking into consideration the concentration of proteins, as well, the graph of amylasic activity is modified, that is, although the maximum enzymatic activity is recorded, too, in the 7th day, a decrease of activity is noticed in the 4th day, to be followed by another increase. As shown by the graphical representation (Fig.7), after the attainment of the maximum value, a decrease of activity occurs in the 8th day, after which a slight increase in the activity of total amylase in the 9th day is evidenced, to be followed by a final decrease.

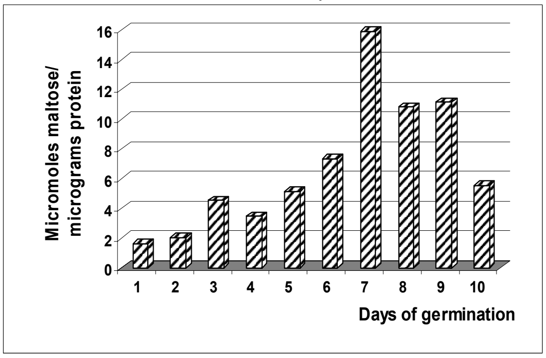

Fig.7 - Dynamics of the specific activity of total amylase in the germination of *Festuca pratensis* seeds

As a function of the average values and standard deviation for all samples under analysis, the upper and lower limits of the variability intervals have been subsequently calculated, on the basis of the *critical* value *t (α, n-1)*, given by *α = 0.05* and *n-1* degrees of freedom, that is *t (0.05, 11)*, as plotted in Figure 8.

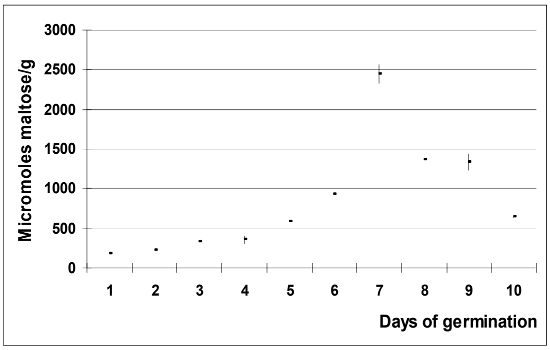

Fig.8 - Confidence intervals of total amylase activity in *Festuca pratensis*

In the case of *Festuca rubra*, the amylasic activity is minimum in the first germination day (173.15 μM maltose / g), a slow increase being recorded in the first 72 hours of germination, followed by a sudden increase of the enzymatic activity (403.50 μM maltose / g) in the 4th day, the maximum value being recorded in the 6th day (1845.00 μM maltose / g). After these increases, the activity of total amylase follows a decreasing curve, so that, 240 hours from the beginning of germination, it reaches a value of 303 μM maltose / g (Fig. 9).

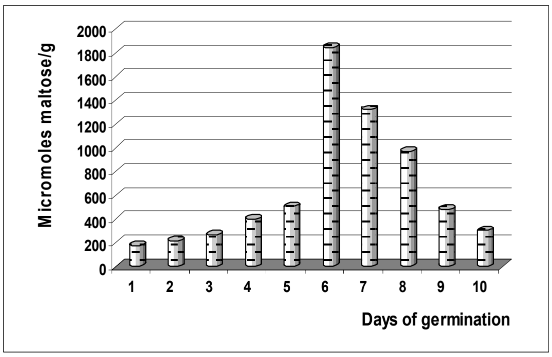

Fig. 9 - Dynamics of the absolute activity of total amylase in the germination of *Festuca rubra* seeds

Unlike *Festuca pratensis*, in which the maximum enzymatic activity is recorded in the 7th germination day, in *Festuca rubra* the enzyme attains its maximum value in the 6th day, the dynamics of amylasic activity being - otherwise - similar (Fig. 10).

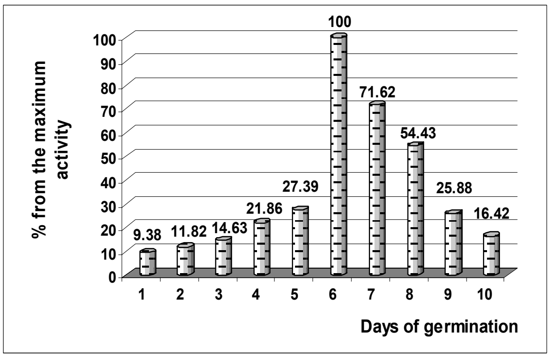

Fig.10 - Dynamics of the relative activity of total amylase in the germination of *Festuca rubra* seeds

24 hours after the beginning of the germination process, the concentration of starch is of 62.2 mg%, which is followed by a slow decrease until the last germination day under analysis (8.8 mg%) (Fig. 11).

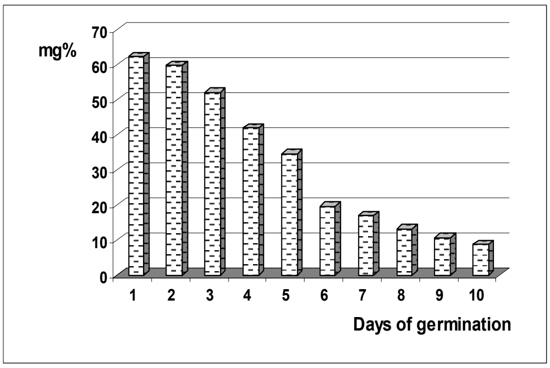

Fig.11 - Starch concentration in germinated seeds of *Festuca rubra*

In this case, too, the concentration of starch decreases more and more, proportionally to the increase of enzymatic activity (Fig. 12).

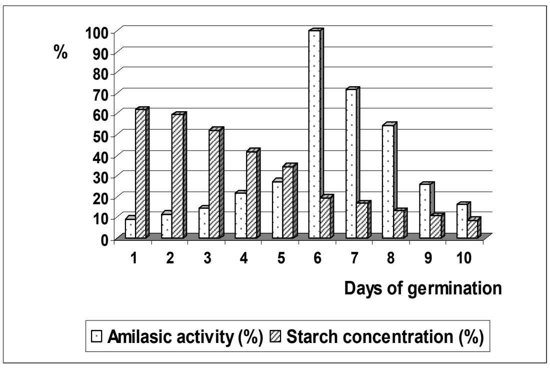

Fig.12 - Comparative representation of starch concentration and enzymatic activity in germinated seeds of *Festuca rubra*

As to protein concentration, one may observe that, even if in the first three days of the experiment it follows a descending curve, an increase is to be noticed between the 4th and the 6th day, which coincides with the maximum enzymatic activity, followed - again - by a decrease (Fig. 13).

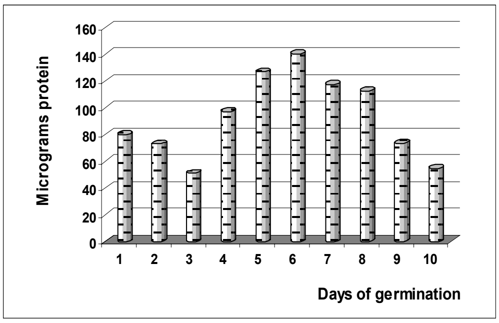

Fig.13 - Dynamics of protein concentration in *Festuca rubra*

As evidenced by the graphical representation, as well, in *Festuca rubra*, the specific activity follows the same curve with the one recorded for *Festuca pratensis* (Fig. 14).

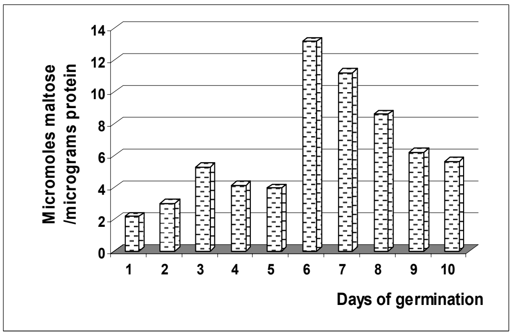

Fig.14 - Dynamics of the specific activity of total amylase in the germination of *Festuca rubra* seeds

The limits of the confidence intervals of enzymatic activity are, once again, very narrow for all samples taken into consideration (Fig. 15).

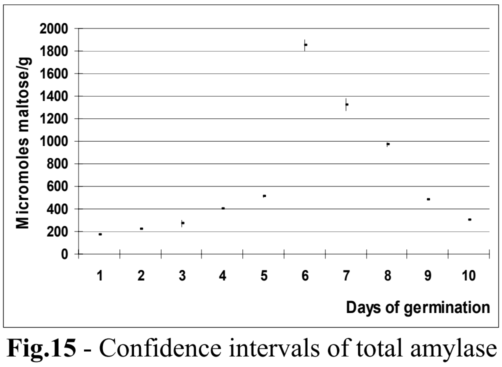

Fig.15 - Confidence intervals of total amylase activity in *Festuca rubra*

As to the dynamics of the absolute activity of total amylase in *Festuca drymeia*, the experimental results evidenced a slow increase in the first 6 germination days, with a maximum enzymatic activity in the 7th day (1762.5 μM maltose / g) after which, similarly with the case of the other two species of the *Festuca* genus under analysis, the enzyme follows a descending curve (Fig. 16).

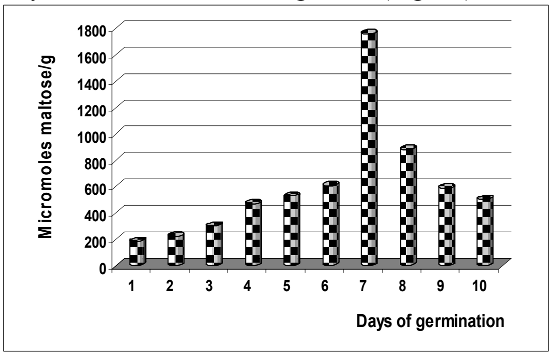

Fig.16 - Dynamics of the absolute activity of total amylase in the germination of *Festuca drymeia* seeds

In *Festuca drymeia*, both percent activity and starch concentration follow the same curve as the one evidenced for *Festuca pratensis*, as also shown graphically (Figs. 17 - 18).

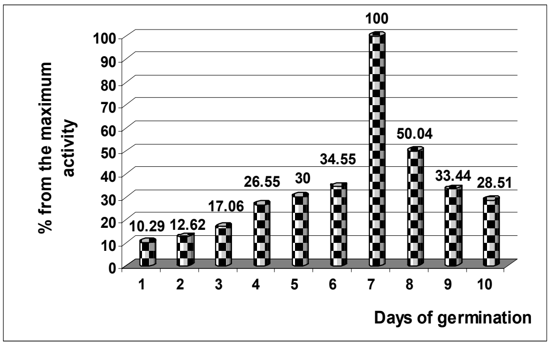

Fig.17 - Dynamics of the relative activity of total amylase in the germination of *Festuca drymeia* seeds

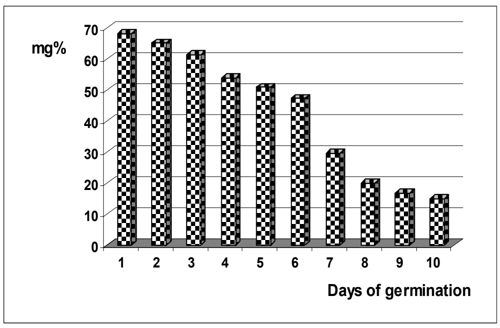

Fig.18 - Starch concentration in germinated seeds of *Festuca drymeia*

As in the preceding cases, the amount of starch decreases more and more, proportionally to the increase of enzymatic activity and, although - after having attained a maximum - the amylasic activity shows a more and more pronounced decrease, the starch concentration continues to decrease, more and more slowly, with the diminution in the activity of total amylase (Fig. 19).

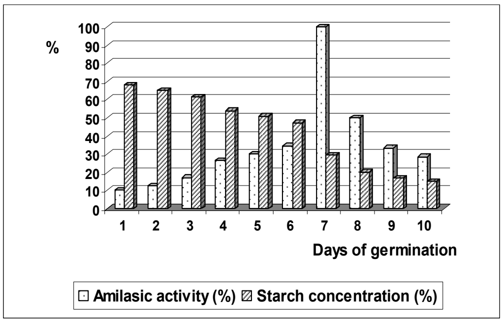

Fig.19 - Comparative representation of starch concentration and enzymatic activity in germinated seeds of *Festuca drymeia*

Protein concentration (employed in the calculation of the specific activity of total amylase - Fig. 20) oscillates over a much larger interval, comparatively with the other two species under study, its values ranging between 130.3 - 403.5 µM maltose / g (Fig. 21).

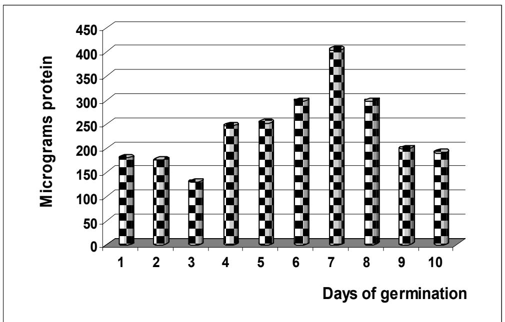

Fig.20 - Dynamics of protein concentration in *Festuca drymeia*

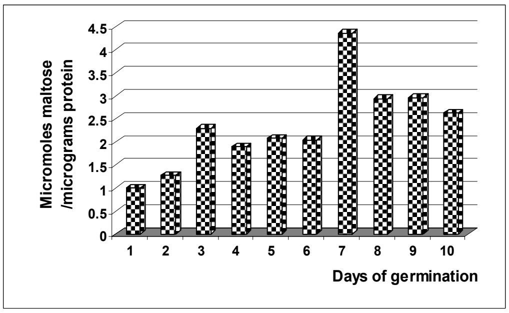

Fig.21- Dynamics of the specific activity of total amylase in the germination of *Festuca drymeia* seeds

As evidenced, too, by the graphical representation, the limits of the confidence intervals of amylasic activity are, once again, extremely narrow (Fig. 22).

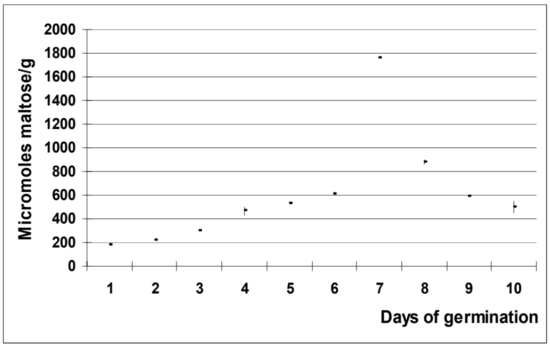

Fig.22 - Confidence intervals of total amylase activity in *Festuca drymeia*

To evidence the possible differences or similarities in the activity of total amylase of the three species belonging to the *Festuca* genus, under analysis, the **ANOVA test - bifactorial I pattern**, with an equal number of observations in the cell, was applied (FOWLER *et al*., 2000).

The test permitted to calculate the square sums, on the basis of variability sources (on columns, rows, on the total and internal interaction), the factors values (on columns, rows and of the interaction), as well as their critical values.

The results of the test showed that the activity of total amylase is strongly influenced by the germination time, being hardly differentiated from one species to another (Fig. 23).

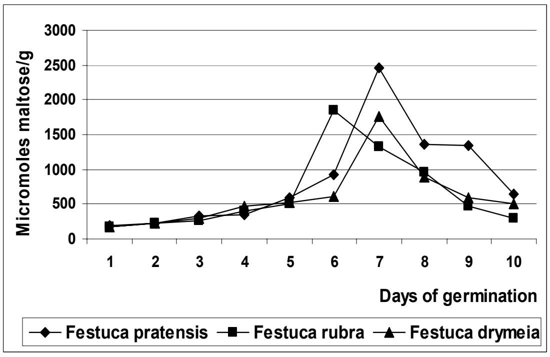

Fig.23 - Comparative representation of the total amylase activity in *Festuca* genus species

Conclusions

The results obtained in the study led to the following general conclusions:

1. In all species of the *Festuca* genus under investigation, the minimum value of total amylase activity is registered in the 1st germination day, with

a maximum in the 6th (*Festuca rubra*) and, respectively, 7th day (*Festuca pratensis*, *Festuca drymeia*).
2. The confidence intervals of the activity of total amylase are relatively narrow, indicating that the results have a very low error degree.
3. Statistical analysis of the experimental results obtained showed that the enzymatic activity is strongly influenced by the germination time, being hardly differentiated from one species to another.
4. The concentration of starch, as a reserve polyglucides, present in high ratios in the seeds of the plants belonging to the *Poaceae* family, decreases progressively along the whole period of seed's germination.
5. Dynamics of total amylase in the seeds of the plants under study demonstrates that, during germination, the starch is mainly mobilized through enzymatic hydrolysis, by amylases.

Rezumat

Lucrarea prezintă rezultatele cercetărilor cu privire la activitatea amilazei totale în cariopsele germinate aparținând la trei specii ale genului *Festuca*, şi anume: *Festuca pratensis*, *Festuca rubra* şi *Festuca drymeia.*

Analiza statistică a rezultatelor experimentale obținute relevă faptul că activitatea enzimatică este influențată puternic de timpul de germinare fiind puțin diferențiată de la o specie la alta.

References

1. ARTENIE VL., TĂNASE E., 1981 - *Practicum de biochimie generală*, Ed. Univ. „Al. I. Cuza", Iaşi, 94 - 99.BODEA, C., 1984 - *Tratat de biochimie vegetală*, Vol. 5, Ed. Didactică şi Pedagogică, Bucureşti, 278 - 281.
2. BURZO I., TOMA S., DOBRESCU A., UNGUREANU L. ŞTEFAN V., 1999 - *Fiziologia plantelor de cultură*, Vol II: *Fiziologia culturilor de câmp*, Întrep. Editorial - Poligrafică, Chişinău, 180 - 186.
3. ŞTEFAN V., 1999 - *Fiziologia plantelor de cultură*, Vol II: *Fiziologia culturilor de câmp*, Întrep. Editorial - Poligrafică, Chişinău, 180 - 186.
4. CIORNEA E., ARTENIE VL., COJOCARU D.C., VASILE G., 2006 a - *On the activity of α-amylase in some culture and spontaneous graminaceae, during their germination period*, An. Şt. Univ. „Alexandru Ioan Cuza" Iaşi, s. II a Genetică şi Biologie Moleculară, Tom VII, Fasc. 1, 37 - 41.
5. CIORNEA E., ARTENIE VL., COJOCARU D.C., VASILE G., 2006 b - *The dynamics of total amylase's activity in Panicum miliaceum and Setaria glauca during the germination period*, An. Şt. Univ. „Alexandru Ioan Cuza" Iaşi, s. II a Genetică şi Biologie Moleculară, Tom VII, Fasc. 1, 43 - 48.
6. CIORNEA E., COJOCARU D.C., VASILE G., 2006 c - *Studiul unor enzime implicate în metabolismul glucidic în semințele germinate la unele graminee cultivate şi spontane*, Lucrări ştiințifice, Seria Zootehnie, Vol. 49, U.S.A.M.V. Iaşi, Ed. „Ion Ionescu de la Brad" Iaşi, 40 - 47.
7. COJOCARU D. C., 2005 - *Enzimologie practică*, Tehnopress, Iaşi, 426 - 429.
8. FOWLER J., COCHEN L., JARVIS P., 2000 - *Practical statistics for field biology*, Second Edition, Ed. by John Wiley & Sons, Ltd., England, 186 - 207.
9. NEAMȚU G., 1981 - *Biochimie vegetală*, Ed. Ceres, Bucureşti, 418 - 420.
10. TĂNASE E., COJOCARU D.C., GOJDA A., M., CIORNEA E., 2000 - *Rechearches on the mobilisation of glucides from cereal seeds during germination*, An. Şt. Univ. „Alexandru Ioan Cuza" Iaşi, s. Biologie Animală, Tom XLVI, 203 - 207.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 184 – 187

CORRELATIONS BETWEEN THE CONTENT OF SOLUBLE AND INSOLUBLE POLYGLUCIDE IN *CLAVICEPS PURPUREA* SKLEROTES FROM DIFFERENT ALKALOIDIC-TYPE STEMS

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ZENOVIA OLTEANU*, ŞTEFANIA SURDU**

ABSTRACT

CIORNEA E., COJOCARU I. S., COJOCARU D., OLTEANU Z., SURDU ŞT., 2006 – Correlations between the content of soluble and insoluble polyglucide in Claviceps purpurea sklerotes from different alkaloidic-type stems. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 184-187.

The study develops a comparative analysis on the concentration of soluble polyglucides - generally acting as reserve substances - and of insoluble polyglucides - playing a plastic role - in *Claviceps purpurea* sklerotes from stems of different alkaloidic type, namely ergotaminic and ergocrystinic.

The results obtained have evidenced no significant differences in the polyglucides' concentration values of the fungus stems under investigation.

Key words: *Claviceps purpurea*, ergotaminic, ergocrystinic, polyglucides

Introduction

The class of fungi is characterized by a remarkable metabolic flexibility, materialized in their ability of using various types and amounts of organic substance from the environment; if adding to this characteristic the special biochemical complexity of the whole *Claviceps* genus, the considerable metabolic capacity of these organisms may be, indeed, evidenced.

The sklerotes of *Claviceps* represent forms of heterogeneous life which, under natural conditions, depend entirely on the nutrients from the host plant. Although both caryopses and sklerotes have the same source of food, their metabolism is different. Finally, the reserve substance from the seeds of the host plant is the starch, while the sklerotes store the lipids, along with which there are synthesized and deposited, as secondary metabolites, the ergotic alkaloids which, quantitatively but mostly qualitatively, differentiate the stems of various alkaloidic type. The varied enzymatic systems characterizing the two partners develop different activities (TABER, 1985; SURDU *et al.*, 1992; SURDU *et al.*, 2005).

Examination of the metabolic relations in the parasite-host relationship provided numerous data, on the basis of which the metabolic ways and the process of biochemical differentiation - known as preceding morphological differentiation and initiation of alkaloidic biosynthesis - could be better understood.

The nutritive requirements of the *Claviceps* stems are varied, once they manifest certain preferences *versus* the hydrocarbonated source. In their turn, the compounds of glucidic nature influence growth and sporulation, while the alkaloidic biosynthesis is either timely or more belated (ICHIYA *et al.*, 1990; NINOMYIA *et al*, 1990).

Material and methods

The biochemical analyses were made on mature sklerotes, on parasites present on ears of autumn rye (the Ergo sort), artificially infected with a suspension of *Claviceps purpurea* conidiae obtained in submerse cultures.

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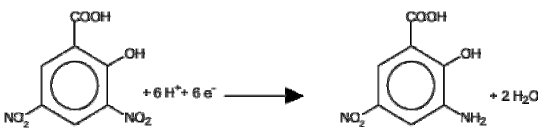
The stems used in the experiments belong to the two different alkaloidic type, namely of the ergocrystinic and ergocriptinic type. For each alkaloidic type, investigations are developed on five batches. Twenty sclerotes have been taken over from each batch and, after a fine jarring of the biological material, an average sample was created. The stems employed are coded, according to the prevailing alkaloid, by a letter followed by a number. Thus, for the predominantly ergocrystinic stems, symbol S is in use, while, for the ergotaminic ones, letter T is used. The stems taken into study differ in both their origin and biochemical characteristics.

On principle, the dosing method is based on the reduction of 3,5 - dinitrosalycilic acid, at warm and in an alkaline medium, in the presence of reducing glucides the orange in color 3-amino-5-nitrosalycilic acid.



The intensity of coloration, proportional to the content of reducing glucides from the biological material subjected to analysis under constant physico-chemical conditions, was determined spectrophotometrically at 500 nm wavelength, the results provided representing the mean values of four determinations (ARTENIE *et al.*, 1981).

The experimental results obtained have been processed statistically, by means of the unifactorial model ANOVA test (FOWLER et al., 2000). Also, the limits of the confidence intervals of the content of soluble and insoluble polyglucides were calculated for both the ergocrystinic and ergotaminic sklerotes (SNEDECOR, 1968).

Results and discussion

Generally, polysaccharides play either a structural (plastic) role of that of an energetic or monosaccharide reserve. However, the main function of the soluble polysaccharides remains the reserve one. Literature data attest the fact that the *Claviceps purpurea* sklerotes contain no starch, although the fungus parasitates the rye or other cereals, the caryopses of which are rich in starch. Generally, the soluble polyglucides from sklerotes are represented by small glycogen grains (FLIEGER *et al.*, 2003).

Another observation refers to the fact that, in the case of ergocrystinic stems, the average content of soluble polyglucides oscillates between 2.2 and 3.6 g% while, in the case of ergotaminic ones, the interval of values is narrower (2.58 - 3.3 g%), meaning, therefore, that the content of soluble polyglucides is much more stable, which agrees with the existing literature data (Figs. 1 - 2).

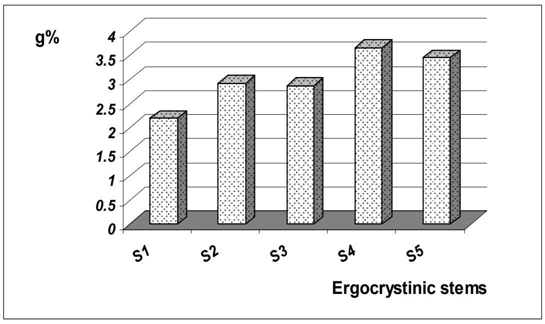


Fig. 1 - Average content of soluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

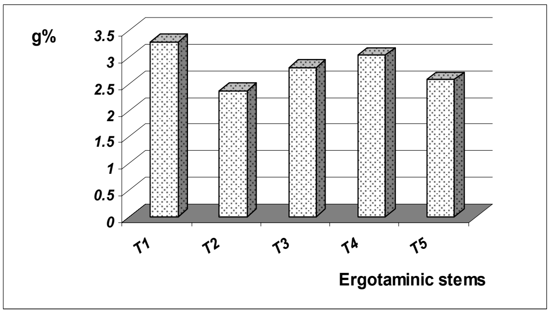


Fig.2 - Average content of soluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

Starting from the average values and standard deviation of the samples under analysis, the upper and lower limits of the confidence intervals have been subsequently calculated, on the basis of the critical value *t (α, n-1)*, given by *α = 0.05* and degrees of freedom *n-1*, that is *t (0.05, 4)*.

As also evidenced by the graphical representation (Figs. 3 - 4), the limits of the confidence intervals of the content of soluble polyglucides in the ergocrystinic *Claviceps purpurea* sklerotes are lower, comparatively with those recorded for ergotaminic sklerotes.

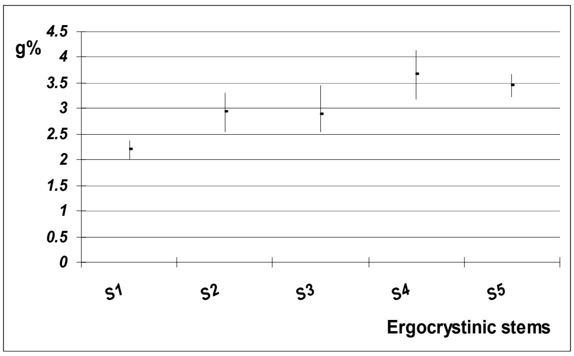


Fig.3 - Confidence intervals of the content of soluble polyglucides in ergocrsytinic sklerotes of *Claviceps purpurea*

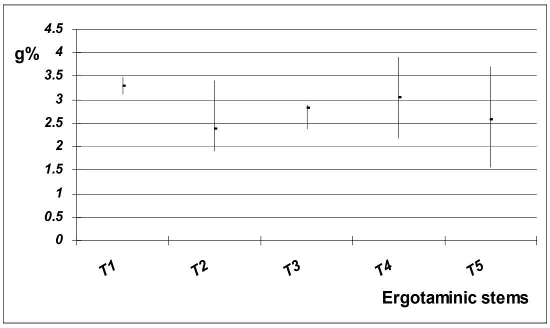


Fig. 4 - Confidence intervals of the content of soluble polyglucides in ergotaminic sklerotes of *Claviceps purpure*

Unlike soluble polysaccharides, the insoluble ones generally play a plastic role. Their determination in the sklerotes belonging to the two stems of *Claviceps purpurea* showed that their weight oscillates between 10.05 - 11.28 g% in ergocrystinic sklerotes, and between 10.04 - 11.43 g%, respectively, in the ergotaminic ones, which means that no considerable differences between the two stems are to be mentioned (Figs. 5 - 6).

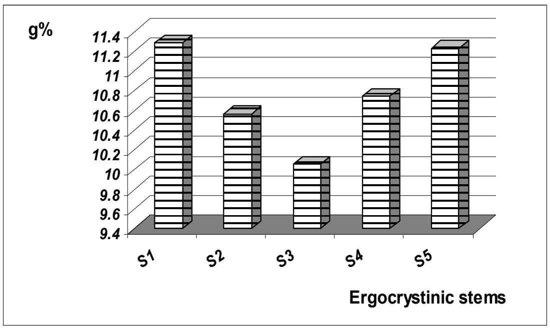


Fig.5 - Average content of insoluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

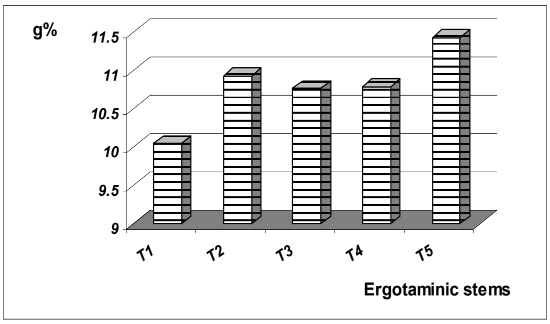


Fig.6 - Average content of insoluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

Unlike soluble polyglucides, in the case of insoluble ones, the limits of the confidence intervals for both types of sklerotes are extremely narrow, for all samples under study (Figs. 7 - 8).

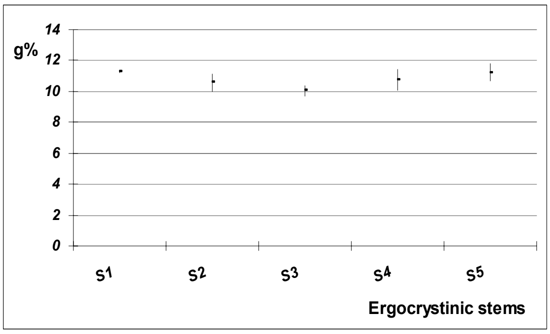


Fig.7 - Confidence intervals of the content of insoluble polyglucides in ergocrsytinic sklerotes of *Claviceps purpurea*

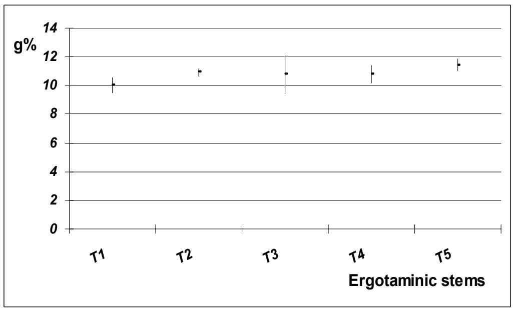


Fig.8 - Confidence intervals of the content of insoluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

To check the possible difference between the two types of stems investigated as to the concentration of the biochemical parameters under analysis, the **unifactorial model ANOVA test**, with an equal number of observations in the cell has been applied, which permitted calculation of the square sums, on the basis of the external, internal and total variability sources, the value of the factor, as well as its critical value (FOWLER *et al.*, 2000).

The results of the test showed that, as to the concentration of soluble and insoluble polyglucides in the *Claviceps purpurea* stems, no considerable differences are to be recorded between the sklerotes of different alkaloidic type (Figs. 9 - 10).

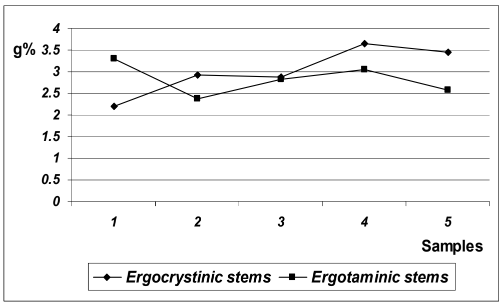


Fig. 9 - Comparative representation of the content of soluble polyglucides in stems of different alkaloidic type

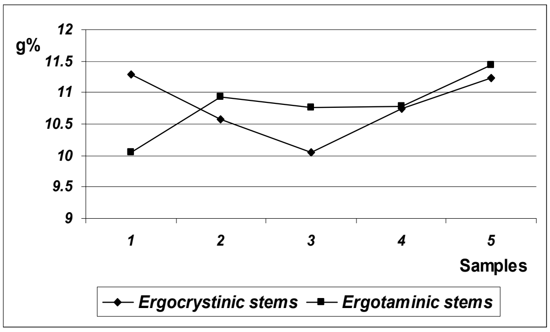


Fig. 10 - Comparative representation of the content of insoluble polyglucides in stems of different alkaloidic type

Conclusions

1. Sklerotes' content of soluble and insoluble polyglucides oscillates between well-determined limits, specific to the two stems taken into study, which agrees with the existing literature data.

2.The concentration of soluble polyglucides is inversely proportional to the weight of the sklerote, which indicates that the process of sklerote's growth is based on the consumption of the reserve glucides.

3.The limits of the confidence intervals of the polyglucide content are, generally, quite narrow, with the exception of those recorded for soluble polyglucides from the ergotaminic type sklerotes.

4.Statistical analysis of the results obtained evidences the fact that, as to the concentration of soluble and insoluble polyglucides in *Claviceps purpurea* stems, no significant differences are to be mentioned.

Rezumat

Lucrarea prezintă studiul comparativ privind concentrația de poliglucide solubile care au, în general rol de rezervă, şi poliglucide insolubile cu rol plastic, în scleroți de *Claviceps purpurea* din tulpini de tip alcaloidic diferit: ergotaminic şi ergocristinic.

Rezultatele obținute nu evidențiază existența unor diferențe semnificative între concentrația de poliglucide în tulpinile fungului luat în studiu.

References

1. ARTENIE VL., TĂNASE E., 1981 - *Practicum de biochimie generală*, Ed. Univ. „Al. I. Cuza" Iaşi, 155 - 157.
2. FLIEGER M., CANTOROVÁ M., BENEŠOVÁ T., PAŽOUTOVÁ S., VOTRUBA J., 2003 - *Kinetics of soluble glucan production by Claviceps viridis*, F. Microbiol., Vol. 48, Nr. 5, 633 - 638.
3. FOWLER J., COCHEN L., JARVIS P., 2000 - *Practical statistics for field biology*, Second Edition, Ed. by John Wiley & Sons, Ltd., England, 186 - 207.
4. ICHIYA N., TOSHIKO K., 1990 - *Ergot alkaloids*, Acad. Press, New York, Vol. 38, 130 - 142.
5. NINOMYIA I., KIGUCHI T., 1990 - *Ergot alkaloids*, Acad. Press, New York, Vol. 38, 12 - 20.
6. SNECODOR G. W., 1968 - *Metode statistice aplicate în cercetările de agricultură şi biologie*, Ed. Didactică şi Pedagogică, Bucureşti, 530 - 535.
7. SURDU ŞT., BĂRA, I.I., TĂNASE, A., TĂNASE, D., OLTEANU, Z., 1992 - *Productivity in Claviceps purpurea Strains of different alkaloidic type*, An. Şt. Univ. „Al. I. Cuza", Iaşi, Tom XXXVIII, s. a II-a, 113 - 116.
8. SURDU ŞT., OLTEANU Z., TRUȚĂ E., 2005 - *Genul Claviceps - Biologie şi Biotehnologie*, Ed. Cermi, Iaşi, 22 - 24, 54 - 55, 131 - 140.
9. TABER W. A., 1985 - *Biology of Claviceps*, in Biology of Industrial Microorganisms, New York, 449 - 486.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 188 – 193

A COMPARATIVE STUDY OF THE MAIN CLASSES OF REDUCING GLUCIDES IN ERGOCRYSTINIC *CLAVICEPS PURPUREA* SKLEROTES

DUMITRU C. COJOCARU*, SABINA IOANA COJOCARU*,
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ABSTRACT

COJOCARU C. D., COJOCARU I. S., CIORNEA E., OLTEANU Z., SURDU ŞT., 2006 – A comparative study of the main classes of reducing glucides in ergocrystinic *Claviceps purpurea* sklerotes. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 188-193.

Knowing the content of reducing glucides in *Claviceps purpurea* sklerotes of the ergocrystinic type, we have made a comparison among the concentrations of each glucidic group. The results evidence that, in the ergocrystinic batch, the monoglucides register quite uniform values, the diglucides occur at a much lower level, representing quantitatively less than 50 % of the monoglucides weight and the content of soluble and insoluble polyglucides also register uniform values, which agrees with the existing literature data. We have observed that glucides are mostly represented by insoluble polysaccharides, followed by monosaccharides and soluble polysaccharides, the lowest amounts recorded referring to diglucides.

Key words: monoglucides, diglucides, soluble polyglucides, insoluble polyglucides, total glucides

Introduction

As known, from a biochemical perspective, *Claviceps purpurea* is a highly complex fungus, so that its investigation should consider both its chemical composition and the biochemical transformations characteristic to it.

The present study is based on a previous investigation of the content of reducing glucides (monosaccharides, disaccharides, soluble polysaccharides and insoluble polysaccharides) in *Claviceps purpurea* sklerotes of the ergocrystinic type, permitting a comparison among the concentrations of each glucidic group.

The *Claviceps purpurea* sklerotes represent forms of heterotrophic life which, under natural conditions, depend entirely on the nutrients provided by the host plant. Although both caryopses and sklerotes are fed from the same source, their metabolism is different. In the end, the reserve substance from the seeds of the host plant is the starch, while, in the sklerotes, deposits of lipids are formed, besides which there are also synthesized and deposited, as secondary metabolites, the ergotic alkaloids, which differentiate – quantitatively but especially qualitatively – the strains of different alkaloidic type. The quite varied enzymatic systems characterizing the two partners have different activities.

The ergocrystinic-type sklerotes, cylindrical in shape, are thinner, with either sharp or cut ends. Numerous sklerotes are curved, sometimes appearing as an incomplete ring. Generally, the surface is smooth. In some strains, the colour, evidencing various shades, is not influenced by the period of sklerotes' formation while, in others, the colour – intensely black–violet – is uniform (Surdu *et al.*, 2005).

One of the main groups of compounds present in this species is represented by polysaccharides. In 2003, Flieger *et al.* drew the attention on the presence of a significant number of *Claviceps purpurea* strains producing considerable amounts of polysaccharides. They are constantly present, either as small glycogen granules in the cytoplasma, or as microfibrils in the cell wall.

The β-1,4- and β-1,6-glucans produced by *Claviceps purpurea* increase medium's viscosity, once they are excreted and degraded in various phases of the development process.

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The trehalose, a substance produced by all superior fungi, is present in *Claviceps purpurea* in concentrations over 14% (Taber, 1985). It is formed of two molecules of glucose and one molecule of clavicepsin which, in its turn, hydrolyzes in two glucose molecules and one manitol molecule.

The nutritive requirements of the *Claviceps purpurea* strains are quite varied, certain preferences towards the hydrocarbonated source being manifested. In their turn, the compounds of glucidic nature influence growth and sporulation, while alkaloidic biosynthesis appears as either more precocious or more delayed (Surdu *et al*., 2005).

Several opinions have been expressed on the way in which the glucose might be utilized. Thus, some authors think that the major pathway is represented by glycolysis, while others consider that the pathway of pentosophosphates is the predominant one. In 1981, Glund observed that, in a strain capable of alkaloidic synthesis, the major pathway for glucose utilization is that of pentosophosphates.

In the species of the *Claviceps* genus, a full operation of all pathways involved in the glucidic metabolism is essential for the growth stage, while the alkaloidic synthesis is favourized by a substantial reduction of their intensity (Surdu *et al*., 2001).

Materials and method

In the experiments, ergocrystinic strains of *Claviceps purpurea* have been employed. The working material is constituted of mature sklerotes, parasitating the ears of autumn rye of the Ergo type, artificially infected with conidial suspensions obtained in submerse cultures. For such an alkaloidic type, experiments have been performed on five batches. 20 sklerotes have been taken over from each batch, for the realization, following a fine jarring of the biological material, of an average sample. The strains utilized in the study are coded according to the prevailing alkaloid, by a letter followed by a number; for predominantly ergocrystinic strains, symbol S has been selected.

Principally, the dosing method is based on the reduction of the 3,5-dinitrosalycilic acid, at warm, in an alkaline medium, in the presence of reducing glucides, to 3-amino-5-nitrosalycilic acid, orange in colour.

The intensity of coloration, which is proportional to the content of reducing glucides from the biological material analyzed under constant physico-chemical conditions, is determined spectrophotometrically, at a 500 nm wavelength.

The determinations were made on an UV-VIS, Jasco V-530-type spectrophotometer, the results obtained, representing the average value of three determinations, being expressed as g% (Artenie *et al.*, 1981).

Results and discussion

The results expressing the content of monosaccharides, listed in Tab.1, evidence certain differences as to the average monoglucide content in the *Claviceps purpurea* ergocrystinic strains considered for the study. Consequently, a possible conclusion might be that, in the ergocrystinic batch, the monoglucides register quite uniform values, the minimum limit being of 2.7802 g%, while the maximum one is of 3.4876 g%.

In all living cells - mono- and polyglucides excepted – there are present oligoglucides, mainly diglucides which, in most cases, act as intermediates of the various metabolic pathways. Dosing of diglucides in the ergocrystinic sklerotes evidence the existence if this category of glucides in *Claviceps purpurea*, as well.

The results (Tab.2) attest that the diglucides occur at a much lower level, representing quantitatively less than 50 % of the monoglucides weight. At the same time, one should observe that the content of diglucides is characterized by a quite narrow interval of values.

Generally, polysaccharides play a structural (plastic) role or act as an energetic and monoglucide reserve. However, the main function of soluble polyglucides is that of reserve.

Literature data attest the fact that the *Claviceps purpurea* sklerotes do not contain starch, although the fungus parasitates the rye or other cereals, the caryopses of which are rich in starch (Surdu *et al*., 2005). Generally, the soluble polyglucides from the sklerotes are represented by small granules of glycogen.

The results of polysaccharides dosing in ergocrystinic sklerotes of *Claviceps purpurea* – presented in Tab.3 – show that, in the case of ergocrystinic strains, the average content of soluble polyglucides oscillates between 2.2 and 3.6 g%, which agrees with the existing literature data. Unlike the soluble polyglucides, the insoluble ones generally play a plastic role. Their determination in the sklerotes belonging to the ergocrystinic strains (Tab.4) indicates that their weight oscillates between 10.05 and 11.28 g%.

Fig. 1 plots graphically the average values of monoglucides in ergocrystinic sklerotes of *Claviceps purpurea*. As illustrated in the figure, the average content of monoglucides in ergocrystinic sklerotes evidences no ample inter-individual variations. The content of diglucides (Fig. 2), soluble (Fig. 3) and insoluble polyglucides (Fig. 4) – cases in which the same low amplitude of the variations among samples may be noticed – has been graphically illustrated in an analogous manner.

Figs. 5 to 8 plot the inferior and superior limits of the confidence intervals, on the basis of the critical value t (α, n-1), given by $\alpha = 0.05$ and n-1 degrees of freedom, *i.e.* t (0.05, 5), values calculated as a function of the average values and of the standard deviation values for all samples under analysis (Fowler *et al*., 2000).

In the case of monoglucides, the intervals are somehow larger, ranging – in the case of sample S5 – between 2.345 and 4.63. Larger intervals also appear in diglucides and soluble polyglucides while, in the case of insoluble polyglucides, the intervals are narrower.

The total glucide content of sklerotes, representing the sum of all monoglucides, diglucides, soluble and insoluble polyglucides, evidences the same characteristic as each fraction in part, occurring – in ergocrystinic strains – within quite a large interval. The graphical representation of all glucidic fractions from the sklerotes (Fig. 9) draws the attention on the weight of each class of the total glucidic fraction, in part. For the strains subjected to analysis, the weight of monosaccharides from the total glucidic fraction varies between 17.1 and 17.6%, that of diglucides is around 4.5%, that of the soluble polyglucides oscillates between 15.7 and 16.9%, while that of the insoluble polyglucides represents about 63%.

Tab. 1 - Content of monoglucides in ergocrystinic sklerotes of *Claviceps purpurea*

No.	Sample	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergocrystinic strains					
1.	S_1	2.7983 2.8388 2.8127	2.8166	0.0118	0.0205
2.	S_2	2.8901 2.9461 2.9218	2.9193	0.0162	0.0280
3.	S_3	2.6122 2.9992 2.7289	2.7801	0.1146	0.1985
4.	S_4	3.4213 3.2986 3.3547	3.3582	0.0354	0.0614
5.	S_5	2.9912 3.8997 3.5719	3.4876	0.2656	0.46

Tab. 2 - Content of diglucides in ergocrystinic sklerotes of *Claviceps purpurea*

No.	Sample	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergocrystinic strains					
1.	S_1	0.8122 0.6736 0.7485	0.7447	0.04	0.0693
2.	S_2	0.6511 0.7177 0.6875	0.6854	0.0192	0.0333
3.	S_3	0.4976 0.7657 0.6459	0.6364	0.0775	0.1343
4.	S_4	0.9704 0.9013 0.9354	0.9357	0.0199	0.0345
5.	S_5	0.6402 0.6624 0.6587	0.6537	0.0068	0.0118

Tab. 3 - Content of soluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

No.	Samples	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergocrystinic strains					
1.	S_1	2.2511 2.107 2.2169	2.1916	0.0434	0.0752
2.	S_2	3.0564 2.7571 2.9735	2.929	0.0892	0.1545
3.	S_3	3.5505 2.256 2.8012	2.8792	0.3671	0.6358
4.	S_4	3.8604 3.473 3.6498	3.661	0.1119	0.1939
5.	S_5	3.3803 3.5503 3.4362	3.4556	0.05	0.0866

Tab. 4 - Content of insoluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

No.	Samples	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergocrystinic strains					
1.	S_1	11.3146 11.2648 11.2865	11.2886	0.0144	0.0249
2.	S_2	10.5238 10.6119 10.7658	10.5678	0.044	0.0622
3.	S_3	9.9049 10.1763 10.0895	10.0569	0.08	0.1386
4.	S_4	10.4527 11.0023 10.7865	10.7471	0.1598	0.2769
5.	S_5	11.4401 10.9983 11.2645	11.2343	0.1284	0.2224

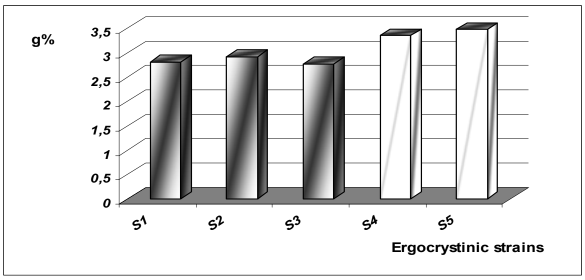

Fig.1 - Average content of monoglucides in ergocrystinic sklerotes of *Claviceps purpurea*

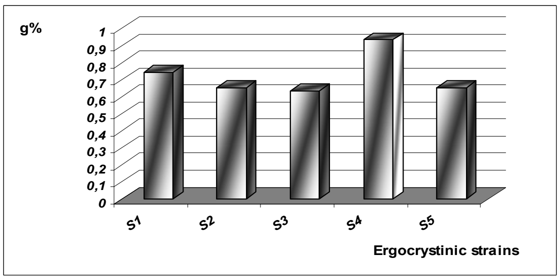

Fig. 2. - Average content of diglucides in ergocrystinic sklerotes of *Claviceps purpurea*

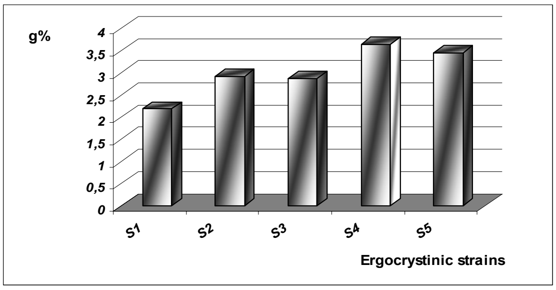

Fig. 3 - Average content of soluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

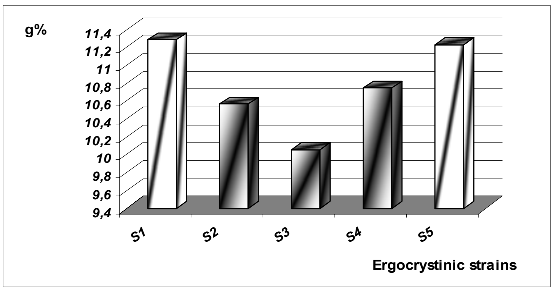

Fig. 4 - Average content of insoluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

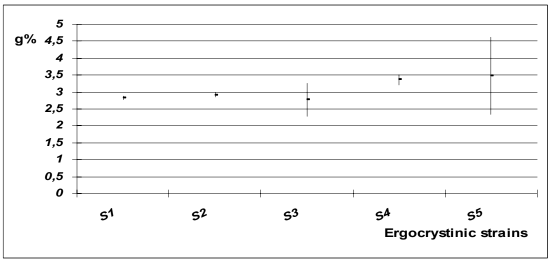

Fig. 5 - Confidence intervals of the average content of monoglucides in ergocrystinic sklerotes of *Claviceps purpurea*

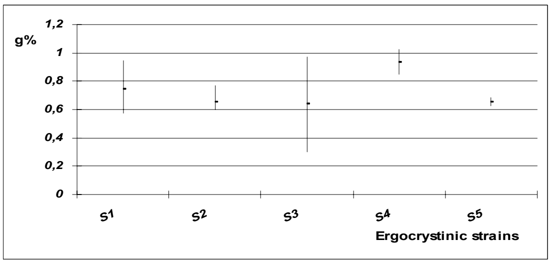

Fig. 6 - Confidence intervals of the average content of diglucides in ergocrystinic sklerotes of *Claviceps purpurea*

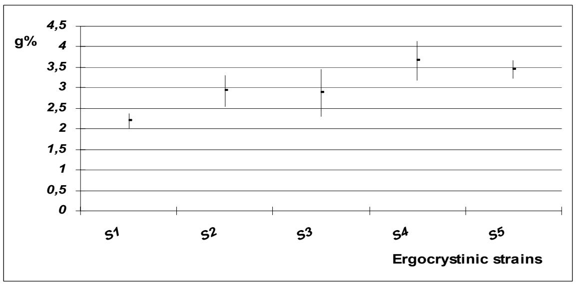

Fig. 7 - Confidence intervals of the average content of soluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

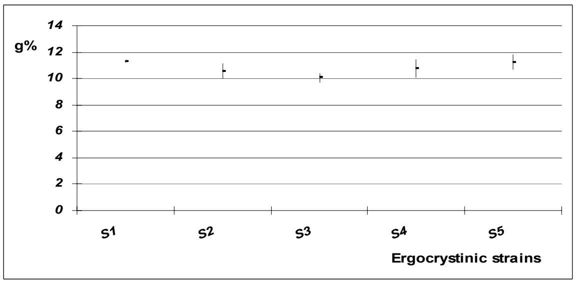

Fig. 8 - Confidence intervals of the average content of insoluble polyglucides in ergocrystinic sklerotes of *Claviceps purpurea*

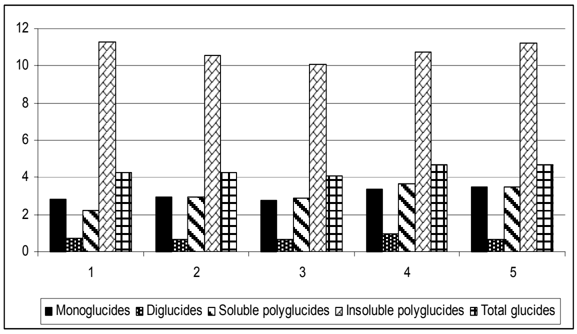

Fig. 9 - Comparative plotting of the content of reducing glucides in ergocrystinic sklerotes of *Claviceps purpurea*

Conclusions

Analysis of the experimental results obtained led to the following general conclusions:

1. From a quantitative point of view, glucides are mostly represented by insoluble polysaccharides (10.05 – 11.28 g%), followed by monosaccharides (2.78 – 3.48 g%) and soluble polysaccharides (2.19 – 3.66 g%), the lowest amounts recorded referring to diglucides (0.63 – 0.93g%).

2. The limits of the confidence intervals plotted as a function of the average values and of standard deviation are – on one hand – very narrow for insoluble polyglucides while, on the other hand,

they are quite large in the case of monoglucides, diglucides and soluble polyglucides.

3. The authenticity of the obtained results is supported by statistical calculations, as well.

Rezumat

Pe baza cunoaşterii conţinutului în glucide reducătoare în scleroţii ergocristinici de *Claviceps purpurea*, am realizat o comparaţie între principalele grupe de glucide. Rezultatele au evidenţiat faptul că, în tulpinile ergocristinice, conţinutul în monoglucide înregistrează valori uniforme, nivelul diglucidelor este foarte scăzut, reprezentând mai puţin de 50% din conţinutul în monoglucide, iar cantităţile de poliglucide solubile şi insolubile de asemenea prezintă limite mici de variaţie, valorile obţinute fiind în deplină concordanţă cu cele din literatura de specialitate. Analizând datele experimentale, am putut ajunge la concluzia că, în scleroţii ergocristinici de *Claviceps purpurea*, cea mai mare pondere o au poliglucidele insolubile, urmate de monozaharide şi polizaharide solubile, cea mai mică proporţie fiind înregistrată la diglucide.

References

1. ARTENIE VL., TĂNASE, E., 1981 - *Practicum de Biochimie Generală*, Ed. Univ. "Al. I. Cuza" Iaşi, 69 - 77
2. FLIEGER M., CANTOROVÁ M., BENEŠOVÁ T., PAŽOUTOVÁ S., VOTRUBA J., 2003 - *Kinetics of soluble glucan production by Claviceps viridis*, F. Microbiol., Vol. 48, Nr. 5, 633 - 638.
3. FOWLER J., COCHEN L., JARVIS P., 2000 - *Practical statistics for field biology*, Second Edition, Ed. by John Wiley & Sons, Ltd., England, 186 - 207.
4. GLUND K., KRISTAN C., SCHLEE, C., 1981 – *Glucose catabolism during alkaloid production in a strain of Claviceps purpurea*, F. Microbiol., Vol. 24, 398.
5. SURDU ŞT., OLTEANU Z., TRUŢĂ, E., 2005 - *Genul Claviceps - Biologie şi Biotehnologie*, Ed. Cermi, Iaşi, 22 - 24, 33 - 42, 54 - 55, 102 - 103, 131 - 140.
6. SURDU ŞT., OLTEANU Z., ZAMFIRACHE M.M., TĂNASE A., TĂNASE D., 2001 - *Factors affecting the production of Claviceps purpurea sclerotia*, 2084 - 2090.
7. TABER, W.A., 1985 - *Biology of Claviceps*, in Biology of Industrial Microorganisms, New York, 449 - 486.

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INVESTIGATION OF THE CONTENT OF REDUCING GLUCIDES IN ERGOTAMINIC-TYPE SKLEROTES OF *CLAVICEPS PURPUREA*

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ABSTRACT

COJOCARU I. S., CIORNEA E., COJOCARU C. D., OLTEANU Z., SURDU ŞT., 2006 – Investigations of the content of reducing glucides in ergotaminic-type sklerotes of claviceps purpurea. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 194-199.

The content of reducing glucides has been studied in *Claviceps purpurea* sklerotes of ergotaminic type and a comparison between the concentration values of each group of glucides has been realized. The results evidence ample inter-individual variations in the average content of monoglucides in the ergotaminic sklerotes. At the same time, one should observe that the content of diglucides is characterized by a quite narrow interval of values, that also are very homogeneous. We have obtained very homogeneous results also in the case of soluble polyglucides. The interval of values of the insoluble polyglucides is very large, this substances representing also the biggest fraction from all glucidic types in *Claviceps purpurea*, followed by monosaccharides and soluble polysaccharides, the lowest quantity being recorded with diglucides.

Key words: monoglucides, diglucides, soluble polyglucides, insoluble polyglucides, total glucides.

Introduction

Full elucidation of the chemical composition and biochemical transformations occurring in *Claviceps purpurea* sklerotes represents the main pathway in the study of this parasite fungus.

With a view of comparing the concentration values of each group of glucides, the content of reducing glucides (mono- and disaccharides, soluble and insoluble polysaccharides) has been studied in *Claviceps purpurea* sklerotes of ergotaminic type.

The *Claviceps purpurea* sklerotes represent forms of heterotrophic life which, under natural conditions, depend entirely on the nutrients provided by the host plant. Although both caryopses and sklerotes are fed from the same source, their metabolism is different. In the end, the reserve substance from the seeds of the host plant is the starch, while, in the sklerotes, deposits of lipids are formed, besides which there are also synthesized and deposited, as secondary metabolites, the ergotic alkaloids, which differentiate – quantitatively but especially qualitatively – the strains of different alkaloidic type. The quite varied enzymatic systems characterizing the two partners have different activities.

The sklerotes of the ergotaminic-type strains are slightly curved, cylindrical in shape, with rounded ends, evidencing surface grooves and either a smooth or rugged surface. Their colour, generally black-violaceous, is darker in the sklerotes of the first generation, while the sklerotes formed in a subsequent stage, showing a surface marked by deeper grooves and numerous cracks, are lighter in colour, some of them brown-grey. Generally, they are smaller and less uniform. In some strains, the morphological aspect of the sklerotes from the two generations is highly different (Surdu *et al*., 2005).

One of the main groups of compounds present in this species is represented by polysaccharides. In 2003, Fleiger *et al.* drew the attention on the presence of a significant number of *Claviceps purpurea* strains producing considerable amounts of polysaccharides. They are constantly present, either as small glycogen granules in the cytoplasma, or as microfibrils in the cell wall.

The β-1,4- and β-1,6-glucans produced by *Claviceps purpurea* increase medium's viscosity, once they are excreted and degraded in various phases of the development process.

The trehalose, a substance produced by all superior fungi, is present in *Claviceps purpurea* in

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concentrations over 14% (Taber, 1985). It is formed of two molecules of glucose and one molecule of clavicepsin which, in its turn, hydrolyzes in two glucose molecules and one manitol molecule.

The nutritive requirements of the *Claviceps purpurea* strains are quite varied, certain preferences towards the hydrocarbonated source being manifested. In their turn, the compounds of glucidic nature influence growth and sporulation, while alkaloidic biosynthesis appears as either more precocious or more delayed (Surdu *et al*., 2005).

Several opinions have been expressed on the way in which the glucose might be utilized. Thus, some authors think that the major pathway is represented by glycolysis, while others consider that the pathway of pentosophosphates is the predominant one. In 1981, Glund observed that, in a strain capable of alkaloidic synthesis, the major pathway for glucose utilization is that of pentosophosphates.

In the species of the *Claviceps* genus, a full operation of all pathways involved in the glucidic metabolism is essential for the growth stage, while the alkaloidic synthesis is favourized by a substantial reduction of their intensity (Surdu *et al*., 2001).

Materials and method

Ergotaminic strains of *Claviceps purpurea* have been employed in the study, the experimental material being represented by matures sklerotes, parasitating the ears of Ergo-kind autumn rye, artificially infected with suspensions of conidiae obtained in submerse cultures.

Investigations have been developed on 5 batches. From each batch, 20 sklerotes were taken over, for the realization – following a fine jarring of the biological material – of an average sample. The strains employed in the study are coded according to the predominant alkaloid, by a letter followed by a number, so that, for the predominantly ergotaminic strains, symbol T is applied. The strains differ as to their origin and biochemical characterictics.

Principally, the dosing method is based on the reduction of the 3,5-dinitrosalycilic acid, at warm, in an alkaline medium, in the presence of reducing glucides, to 3-amino-5-nitrosalycilic acid, orange in colour.

The intensity of coloration, which is proportional to the content of reducing glucides from the biological material analyzed under constant physico-chemical conditions, is determined spectrophotometrically, at a 500 nm wavelength.

The determinations were made on an UV-VIS, Jasco V-530-type spectrophotometer, the results obtained, representing the average value of three determinations, being expressed as g% (Artenie *et al.*, 1981).

Results and discussion

The results expressing the monosaccharide content are listed in Tab. 1 and graphically illustrated in Figs. 1 and 2.

The table shows that, in the samples belonging to the ergotaminic batch, the monoglucides appear within a quite large concentration range (*i.e*., between 2.6258 and 3.7991 g %).

Fig. 1, plotting the average values of monoglucide concentrations in ergotaminic *Claviceps purpurea* sklerotes, evidences ample inter-individual variations in the average content of monoglucides in the ergotaminic sklerotes.

Fig. 2 illustrates the superior and inferior limits of the confidence intervals, on the basis of the critical value t (α, n-1), given by α=0.05 and n-1 degrees of freedom, that is t (0.05, 5), (values) calculated both from the average values and from the values of standard deviation for all samples under analysis (Fowler *et al*., 2000). In the case of monoglucides, the intervals are somewhat larger, ranging – for sample T3, for exemple – between 1.401 and 5.773.

In all living cells - mono- and polyglucides excepted – there are present oligoglucides, mainly diglucides which, in most cases, act as intermediates of the various metabolic pathways. Dosing of diglucides in the ergotaminic sklerotes evidence the existence if this category of glucides in *Claviceps purpurea*, as well.

The results (Tab. 2) attest that the diglucides occur at a much lower level, representing quantitatively less than 50 % of the monoglucides weight. At the same time, one should observe that the content of diglucides is characterized by a quite narrow interval of values.

The graphical representation of the diglucide content (Fig. 3) evidences the homogeneity of the obtained results.

In a similar manner, the superior and inferior limits of the confidence intervals have been established for all samples under analysis.

Generally, polysaccharides play a structural (plastic) role or act as an energetic and monoglucide reserve. However, the main function of soluble polyglucides is that of reserve. Literature data attest the fact that the *Claviceps purpurea* sklerotes do not contain starch, although the fungus parasitates the rye or other cereals, the caryopses of which are rich in starch (Surdu *et al*., 2005). Generally, the soluble polyglucides from the sklerotes are represented by small granules of glycogen.

The results of soluble polysaccharides' dosing in ergotaminic sklerotes of *Claviceps purpurea*, listed in Tab. 3, show that, in the case of ergotaminic strains, the average content of soluble polyglucides oscillates between 2.78 and 3.3 g% - that is, it is much more stable.

Depending on the average values, as well as on the values of the standard deviation of all samples subjected to analysis, the superior and inferior limits of the confidence intervals have been subsequently calculated, on the basis of the critical value t (α, n-

1), given by α=0.05 and n-1 degrees of freedom, that is t (0.05, 5), as graphically represented in Fig. 6.

Unlike the soluble polysaccharides, the insoluble ones generally have a plastic role. Their determination in *Claviceps purpurea* sklerotes (Tab. 5) evidences that – in the case of ergotaminic sklerotes – their weight oscillates between 10.04 and 11.43 g%.

The graphical illustration provided in Figure 7 evidences the differences appearing among the parallel samples of the same batch.

Similarly with the case of other biochemical parameters under investigation, the confidence intervals have been plotted for insoluble polyglucides as well. As shown in Fig. 8, they are extremely narrow, for all samples considered.

The sklerotes content in total glucides, representing the sum of all monoglucides, diglucides, soluble and insoluble polyglucides, shows the same aspect, noticed for each sample in part, ranging over a quite narrow interval in the case of ergotaminic strains.

The graphical representation of all glucidic fractions from the sklerotes (Fig. 9) provides indications on the importance of each class of the total glucidic fraction in part. Thus, the part of monosaccharides from the total glucidic fraction oscillates between 17 and 17.5 %, that of diglucides between 4.4 and 4.5%, that of soluble polyglucides between 15.8 and 16.8%, while the insoluble polyglucides represent about 62%.

Tab. 1 - Representation of the monoglucide content in ergotaminic sklerotes of *Claviceps purpurea*

No.	Samples	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergotaminic strains					
1.	T_1	2.5396 2.7128 2.6594	2.6372	0.0512	0.0886
2.	T_2	2.5053 2.7154 2.6569	2.6258	0.0626	0.1084
3.	T_3	2.573 4.1407 4.049	3.5875	0.5079	0.8798
4.	T_4	2.9561 2.7726 2.8615	2.8634	0.0529	0.0917
5.	T_5	3.9382 3.4566 4.0026	3.7991	0.1722	0.2983

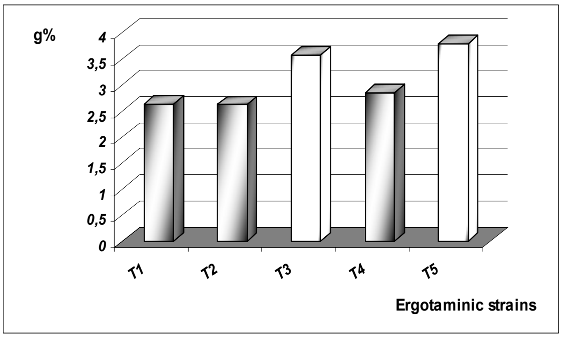

Fig.1 - Average content of monoglucides in ergotaminic sklerotes of *Claviceps purpurea*

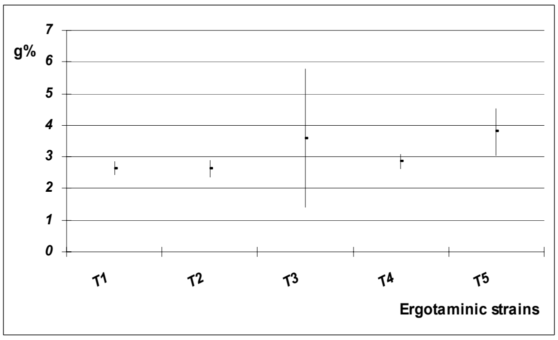

Fig.2 - Confidence intervals of the average content of monoglucides in ergotaminic sklerotes of *Claviceps purpurea*

Tab. 2 - Representation of the diglucide content in ergotaminic sklerotes of *Claviceps purpurea*

No.	Samples	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergotaminic strains					
1.	T_1	0.882 0.6869 0.7746	0.7811	0.0564	0.0977
2.	T_2	0.9863 0.8105 0.8751	0.8906	0.0513	0.0889
3.	T_3	0.9229 0.7098 0.72	0.7842	0.0693	0.1201
4.	T_4	0.9657 1.0199 0.9876	0.991	0.0157	0.0272
5.	T_5	1.0412 0.5785 0.9957	0.8718	0.1472	0.255

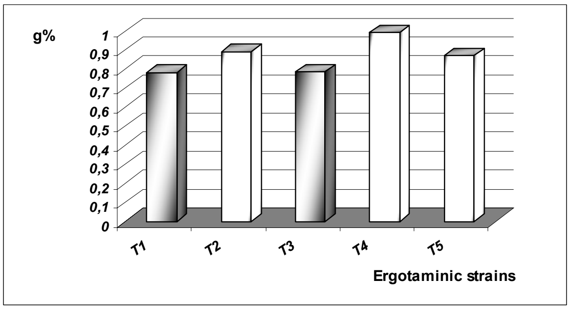

Fig.3 - Average content of the diglucides in ergotaminic sklerotes of *Claviceps purpurea*

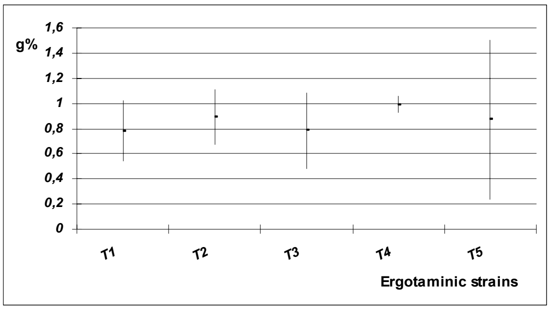

Fig.4 - Confidence intervals of the average content of diglucides in ergotaminic sklerotes

Tab. 3 - Representation of the soluble polyglucide content in ergotaminic sklerotes of *Claviceps purpurea*

No.	Samples	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergotaminic strains					
1.	T_1	3.3788 3.2246 3.2968	3.3	0.0445	0.0771
2.	T_2	2.0501 3.5603 2.7568	2.789	0.4362	0.7556
3.	T_3	3.2281 2.4092 2.8143	2.8187	0.4094	0.5789
4.	T_4	2.704 3.3985 3.0359	3.0461	0.205	0.3473
5.	T_5	1.4784 3.9597 2.3063	2.5814	0.7293	1.2633

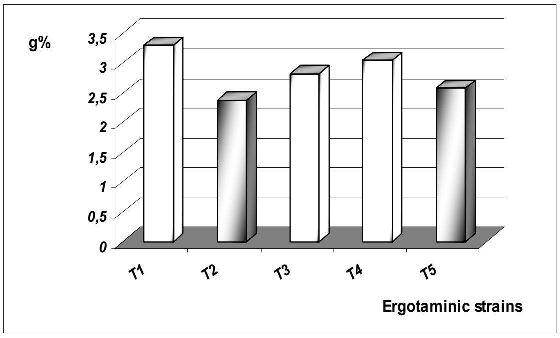

Fig.5 - Average content of the soluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

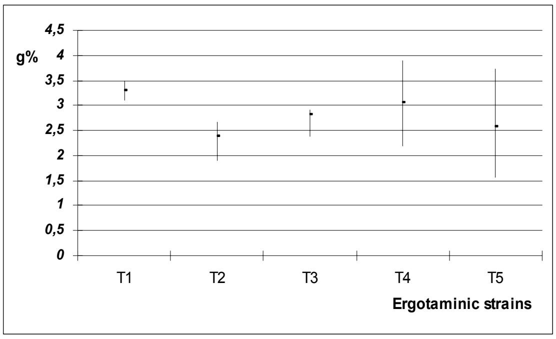

Fig.6 - Confidence intervals of the average content of soluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

Tab. 4 - Representation of the insoluble polyglucide content in ergotaminic sklerotes of *Claviceps purpurea*

No.	Samples	Individual results (g%)	Average value (g%)	Standard error	Standard deviation
Ergotaminic strains					
1.	T_1	9.8496 10.2706 10.0132	10.0444	0.1225	0.2122
2.	T_2	10.8106 11.0128 10.9568	10.9267	0.0602	0.1043
3.	T_3	11.3404 10.6881 10.2564	10.7616	0.315	0.5457
4.	T_4	10.5355 11.0321 10.7954	10.7876	0.1434	0.2483
5.	T_5	11.2301 11.5538 11.5068	11.4302	0.1009	0.1749

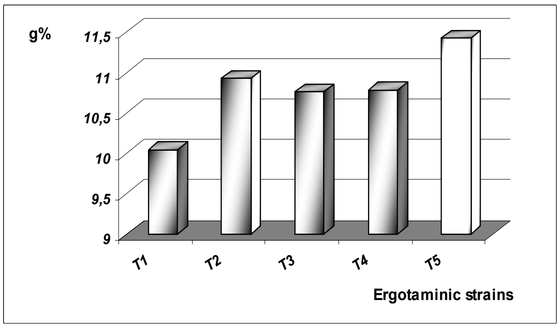

Fig.7 - Average content of the insoluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

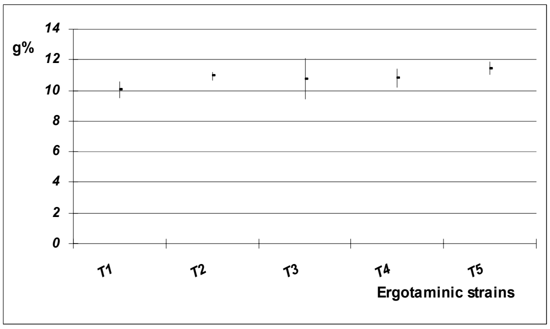

Fig.8 - Confidence intervals of the average content of insoluble polyglucides in ergotaminic sklerotes of *Claviceps purpurea*

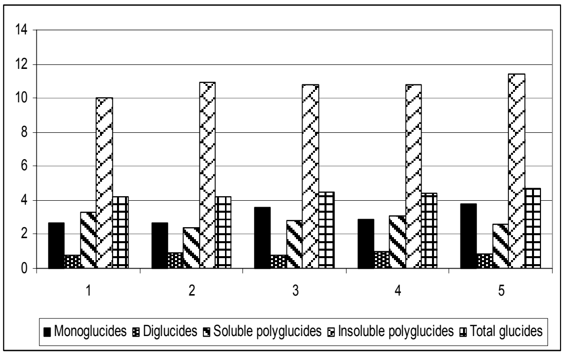

Fig. 9 - Comparative representation of the content of reducing glucides in ergotaminic sklerotes of *Claviceps purpurea*

Conclusions

Analysis of the experimental results obtained led to the following general conclusions:

✓ From a quantitative point of view, the glucides are represented, to a considerable extent, by insoluble polysaccharides, followed by monosaccharides and soluble polysaccharides, the lowest quantity being recorded with diglucides.

✓ The limits of the confidence intervals plotted as a function of the average values and standard deviation, on the basis of the critical value t (α, n-1), given by α= 0.05 and n-1 degrees of freedom are, on one hand, quite narrow in the case of insoluble polyglucides and monoglucides while, on the other hand, they are extremely large for soluble polyglucides and diglucides.

✓ The authenticity of the results obtained is statistically confirmed.

Rezumat

În scleroţii ergotaminici de *Claviceps purpurea* a fost studiat conţinutul în glucide reducătoare în scopul realizării unei comparaţii între principalele clase de zaharide. Rezultatele au evidenţiat ample variaţii ale conţinutului de monoglucide. În acelaşi timp, s-a observat faptul că, in cazul diglucidelor, valorile sunt foarte scăzute, dar şi foarte omogene. Tot rezultate omogene au putut fi evidenţiate şi în cazul poliglucidelor solubile. Intervalul de valori obţinute în urma dozării poliglucidelor insolubile este foarte larg, aceste substanţe reprezentând, de asemenea, fracţiunea glucidică cu cea mai mare pondere în scleroţii ergotaminici de *Claviceps purpurea*, fiind urmată de monoglucide, poliglucide solubile şi diglucide.

References

1. ARTENIE VL., TĂNASE E., 1981 - *Practicum de Biochimie Generală*. Ed. Univ. "Al. I. Cuza" Iaşi, 69 - 77
2. FLIEGER M., CANTOROVÁ M., BENEŠOVÁ T., PAŽOUTOVÁ S., VOTRUBA J., 2003 - *Kinetics of soluble glucan production by Claviceps viridis*. F. Microbiol., Vol. 48, Nr. 5, 633 - 638.
3. FOWLER J., COCHEN L., JARVIS P., 2000 - *Practical statistics for field biology*. Second Edition, Ed. by John Wiley & Sons, Ltd., England, 186 - 207.
4. GLUND K., KRISTAN C., SCHLEE C., 1981 – *Glucose catabolism during alkaloid production in a strain of Claviceps purpurea*. F. Microbiol., Vol. 24, 398.
5. SURDU ŞT., OLTEANU Z., TRUŢĂ E., 2005 - *Genul Claviceps - Biologie şi Biotehnologie*. Ed. Cermi, Iaşi, 22 - 24, 33 - 42, 54 - 55, 102 - 103, 131 - 140.
6. SURDU ŞT., OLTEANU Z., ZAMFIRACHE M.M., TĂNASE A., TĂNASE D., 2001 - *Factors affecting the production of Claviceps purpurea sclerotia*. 2084 - 2090.
7. TABER W. A., 1985 - *Biology of Claviceps*. *In*: Biology of Industrial Microorganisms, New York, 449 - 486.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 200 – 203

STUDIES CONCERNING THE QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF *ORIGANUM VULGARE* SPECIES, AS A UTILE PLANT, CULTIVATED IN BIOLOGICAL SYSTEM

MARCELA FĂLTICEANU*, TINA OANA CRISTEA*, IOAN BURZO**, CREOLA BREZEANU**, MARIAN BREZEANU**, SILVICA AMBĂRUŞ*

ABSTRACT

FĂLTICEANU M., CRISTEA O. T., BURZO I., BREZEANU C., BREZEANU M., AMBĂRUŞ S., 2006 – Studies concerning the quantitative and qualitative characteristics of *Origanum vulgare* species, as a utile plant cultivated in biological systems. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 200-203.

The researches were accomplished at V.R.D.S. Bacau, during 2002-2006 years, on two cultivars of *Origanum vulgare* L.: a local population, originated from the south of Italy and a line obtained through individual and on families repeated selections, the main selection criteria being the decorative character, adapted for pot cultivations.

The cultivation was conducted according with the biologic agriculture regulations (low inputs). Due to the fact that *Origanum vulgare* is a species recognised first of all as a spicy, aromatic and medicinal plant the studies were focused also on the determination of the mineral content and the essential volatile oil components.

Keywords: *Origanum vulgare*, mineral content, essential volatile oil components

Introduction

Origanum vulgare L., common name oregano, origami, arigan, marjoram belongs to *Lamiaceae* family and its origin habitat is Europe.

Oregano is a perennial plant of 0,6 – 0,8m high. The flowers are small, coloured in red till lilac-lavender. It blossom from July till September, being pollinated by bees. The utility rate of plants is 3 : 5.

The plant is tolerant to strong winds, can be cultivated on all types of soils but prefers well drained soils. The plants prefer light but can grow also in shadow.

In the literature is mentioned as a plants with multiple uses: *culinary* (as a condiment plant or for the preparation of a aromatised tea, the leaves can be consumed fresh or cooked); *ornamental* (is decorative through port, bush and flowers: often is cultivated in pots); m*edicinal* (is has an antiseptically and expectorant effects, being used also in affections of respiratory systems, indigestions, arthritis, aromatherapy etc); melliferous (is a good melliferous plant); *in biologic agriculture* (with repellent effect for insects, is recommended for association with many vegetable species, also because the plants cover very well the soil, thus providing an herbicide effect); *cosmetics* (perfume, soap, spay industry).

The cultivation is relatively simple, is propagated through seeds that can be directly sown into the soil yearly in the spring. The crop can also be established through transplants. The plants can be propagated also vegetative, either through the separation of plants in the spring or autumn or through cuttings harvested from the plant's basis, rooted and planted in the field in the summer.

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Materials and methods

The researches were accomplished at V.R.D.S. Bacau, during 2002-2006 years, on two cultivars of *Origanum vulgare* L.: a local population, originated from the south of Italy and a line obtained through individual and on families repeated selections, the main selection criteria being the decorative character, adapted for pot cultivations.

For the decorative characters the following quantitative and qualitative characteristics have been screened: plant's height; bush diameter; the port; the ratio height/diameter, the number of floral cane per plant; the inflorescence diameter; the colour of flowers; the blossom period; the blossom precocity; the resistance to low temperatures during the winter, the degree of plant's branching.

The cultivation was conducted according with the biologic agriculture regulations (low inputs): two phasial fertilisations with Cropmax 0,2 %, in the vegetation period and before blossom; four manual weeding on row and three with machines between the rows.

The dry matter and water contain was determined through the drying of plants at 105°C.

The minerals were determined through the calcinations of plants at 560°C, followed by the solubilisation in HNO3 concentrated and in solution of 1%, being analysed through an inductor spectrometer coupled with plasma (ICP-ES) IRIS INTREPRID.

The extraction of the volatile oil was achieved through hydro-distillation in an equipment type Neoclevenger.

The separation of the volatile compounds was realised through a chromatograph with gas Agilent, utilising an capillary column DB-5 of 25 m long. The utilised gas was helium.

The identification of the compounds was achieved through a spectrometric detector (Agilen), and the verification of the results was made based on Kovats indices.

Results and discussions

At the *Origanum vulgare* species, the biologic material from the germplasm collection is extremely valuable for its utilisation in the breeding program for the creation and promotion of new cultivars.

The studies regarding the quantitative characteristics, the main criteria for the initial breeding material creation and selection, through which the decorative characters are underlined, are presented in tab. 1.

Tab. 1 - The quantitative characteristics of the initial breeding material

Cultivar	Plant's height cm	Plant's diameter cm	Ratio H/D	No of flower cane/ plant	Length of flower cane cm	Diameter of inflorescence cm
Local population	45-50	35-40		7-10	40-45	4-5
Line GOV/2004	35-45	30-45		8-12	30-55	5-7

The studies concerning the qualitative characters are focused toward the plant's port, the colour of flowers, blossom period, earliness at blossom, resistance to low temperatures during the winter, the degree of plant's branching. The results are presented in tab. 2.

Tab 2 - The qualitative characteristics of the selected lines

Cultivar	Plant's port	Colour of flowers	The blossom beginning	The blossom period	Resis-tance to winter	Bran-ching degree
Local population	bush	pink-lilac	20-25 June	June - Aug	good	strong
Line GOV /2004	branched bush	dark pink-lilac	10-55 June	June - Sept	very good	very strong

Due to the high variability degree of the initial biologic material, the individual selection was made on mother plants (vegetative), followed by the selection on families obtained after the generative multiplication (with seeds from elite plants that produced seeds in the same year of vegetation). Thus, we tried to shorten the selection period, the stabilisation of the selected line and the achievement of the objectives established from decorative point of view. Another goal was the achievement of the selected material uniformity.

Due to the fact that *Origanum vulgare* is a species recognised first of all as a spicy, aromatic and medicinal plant the studies were focused also on the determination of the mineral content and the essential volatile oil components.

The studies concerning the mineral content from mature stems, young stems, leaves, flowers and roots, expressed in mg/100 g f.w. (Table 3) shows that, in all parts of plants the quantities of calcium and potassium are the highest: the calcium vary from 562, 36 mg/100 g f.w. (leaves) to 116,79 mg/100 g f.w (roots); the determined potassium

shows the fact that the highest accumulations are in leaves (1970 mg/100 g f.w) and flowers (557,64 mg/100 g f.w). High values were recorded for magnesium in flowers (132,37 mg/100 g f.w), young stems (101,66 mg/100 g f.w) and roots (98,61 mg/100 g f.w).

In the young stems the highest content is in: Ca (522,34 mg/100 g f.w), K (216,33 mg/100 g f.w) and Mg (101,66mg/100 g f.w).

In the mature stems the highest content is in:: K (227,49 mg/100 g f.w) and Ca (211,54 mg/100 g f.w).

In leaves, the highest content is in:: K (1970,35 mg/100 g f.w), Ca (562,36 mg/100 g f.w) and Ba (129,68 mg/100 g f.w). Tracks of Mg, Al and Na minerals can be also noted.

In flowers, the highest content is in:: K (557,64 mg/100 g f.w), Ca (163,77 mg/100 g f.w), Ba (116,74 mg/100 g f.w) and Al (116,41 mg/100 g f.w).

In roots, the highest content is in: K (331,06 mg/100 g f.w), Ca (116,79 mg/100 g f.w), Al (98,98 mg/100 g f.w) and Mg (98,61 mg/100 g f.w). Tracks of Fe and Na minerals can be also noted.

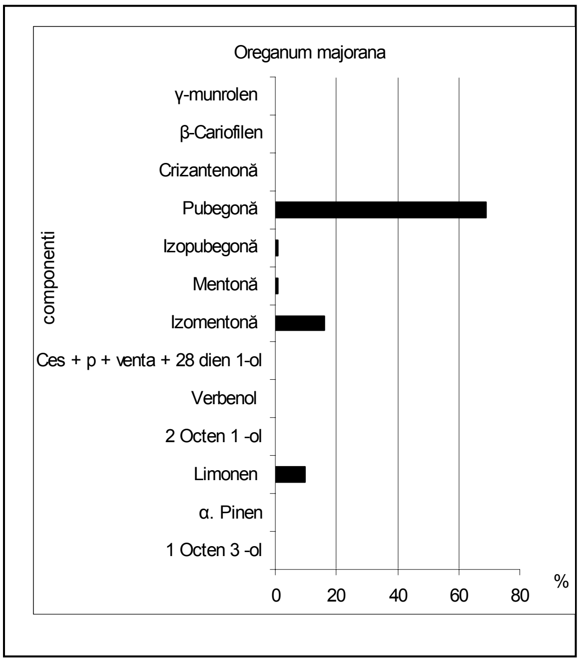
Tab. 3 - The mineral content per plant`s organs at the analysed population of *Origanum vulgare* (mg/100 g f.w.)

Element	Young stems	Mature stems	Leaves	Flowers	Roots
Al	34,35	10,33	40,98	116,41	98,98
B	77,75	0,24	0,69	0,518	0,48
Ba	0,00	48,76	129,68	116,74	97,82
Ca	522,34	211,54	562,36	163,77	116,79
Cr	0,144	0,08	0,25	0,26	0,23
Cu	0,21	0,22	0,58	0,417	0,33
Fe	21,87	6,79	17,26	82,61	68,53
K	216,33	227,49	1970,35	557,64	331,06
Mg	101,66	49,65	80,67	132,37	98,61
Mn	1,29	0,47	0,77	2,836	1,96
Na	10,15	9,06	47,20	48,09	40,04
Ni	0,00	0,00	0,00	0,15	0,00
P 1859	4,45	6,87	14,90	4,72	2,72
P 2136	10,62	9,20	23,92	9,23	6,11
Pb	0,07	0,08	0,13	0,10	0,06
Sr	1,45	0,44	2,02	0,40	0,22
Zn	0,62	0,54	1,50	1,86	1,36

Tab. 4 - The analysis of volatile oil 1% in pentane

The content in volatile oil	%
1 Octen 3 -ol	0,42
α. Pinen	0,48
Limonen	**9,81**
2 Octen 1 -ol	0,10
Verbenol	0,22
Ces + p + venta + 28 dien 1-ol	0,18
Izomentona	**16,28**
Mentona	**1,01**
Izopubegona	0,95
Pubegona	**69,05**
Crizantenona	0,30
β-Cariofilen	0,35
γ-munrolen	0,11

Fig. 1 - Graphycal representation



The compounds of the volatile oils that were identified through the correlation between the spectrum and the retention time (Table 4 and Figure 1), shows that, the most important compounds are: Pubegona (69,5%), Izomentona (16,28%), Limonen (9,81%) şi Mentona (1,01%). Except the Izopubegona compound (0,95%), the rest of them are registered below 0,5%.

The chromatogram of the essential oils is presented in Fig. 2.

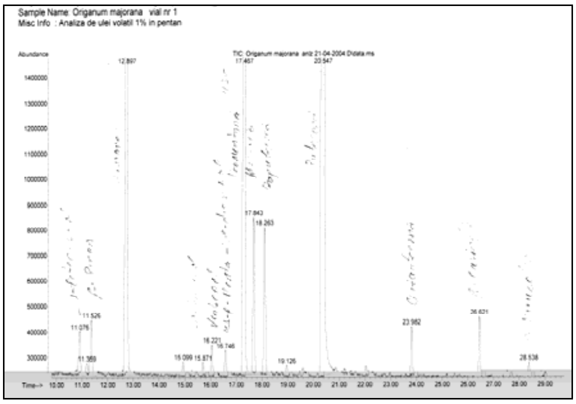


Fig. 2 - The chromatogram of the essential oils at *Origanum vulgare*

Conclusions

The accomplished studies underline the value of the biologic material that was created, selected and multiplied at V.R.D.S. Bacau at *Origanum vulgare* L. specie, during 2002-2006 years.

The utility as a decorative specie is emphasized by the quantitative and qualitative characteristics, followed and accomplished through selection and propagation, both for the creation of the initial material and for the breeding program.

The studies concerning the content in minerals, on mature stems, young stems, leaves, flowers and roots expressed in mg/100 g f.w., shows the fact that in all plant's parts the calcium and magnesium content is the highest; the determined potassium shows the biggest accumulations in leaves. Magnesium has high values in flowers, young stems and roots. The highest content of the mature stems is in K and Ca.

The study of the volatile oil content through the identification of a number of 13 compounds, confirms the multiple utility of the plant (especially as a spicy, aromatic and medicinal plant).

The cultivation in unconventional conditions, in the perimeter of the biologic farm from V.R.D.S.Bacau, through the application of the low input technologies, assures the quality of the selected and propagated biologic material.

References

1. BURZO I., DOBRESCU A., BĂDULESCU L., MIHĂIESCU D., BĂLAN D., 2005 – *Fiziologia plantelor*, vol. VI,VIII, Ed. Elisavaros, Buc.
2. CĂLIN M., 2005 – *Ghidul recunoaşterii şi controlului dăunătorilor plantelor legumicole cultivate în agricultură biologică*. Ed. Tipo Activ, Bacău.
3. FĂLTICEANU M., 2006 – *Plante utile pentru grădina Dumneavoastră*, Tipo-Moldova, Iaşi. ISBN 973-8900-18-2
4. FĂLTICEANU M., 2005 – *Plante utile în practicarea agriculturii biologice*. Editura Tipo Activ, Bacău. ISBN 973-87136-9-2
5. MUNTEANU N., 2000 – *Ameliorarea plantelor ornamentale.* Editura "Ion Ionescu de la Brad", Iaşi
6. STOIAN L., 2005 – *Ghid practic pentru cultura biologică a legumelor*. Editura Tipo Activ, Bacău.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 204 – 207

DYNAMICS OF THE ACTIVITY OF TOTAL AMYLASE DURING THE GERMINATION PERIOD IN SOME GRAMINACEAE SPECIES FROM THE SPONTANEOUS FLORA

ALEXANDRU VALENTIN NEAGU*, ELENA CIORNEA*, GABRIELA VASILE*

ABSTRACT

NEAGU A. V., CIORNEA E., VASILE G., 2006 – Dynamics of the activity of total amylase during the germination period in some graminaceae species from spontaneous flora. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 204-207.

For the practical realization of the present study, germinated caryopses belonging to three species of spontaneous graminaceae from the *Poaceae* family have been used. Caryopses’ germination was performed in Petri plates lined with filter paper wet with distilled water, samples’ taking over being made each 24 hours. The obtained experimental results have evidenced certain differences in the amylasic activity, on one side, as well as in the germination time, on the other.

Key words: total amylase, *Setaria glauca*, *Festuca drymeia*, *Bromus japonicus*

Introduction

The extremely complex process of seed germination involves a multitude of biochemical and physiological processes through which the glucides, lipids and reserve proteins are mobilized for assuring the precursors necessary for the biosynthetic processes developed in the embryo and in the future plant, up to the occurrence of photo synthetic transformations (BODEA, 1984).

One of the main reserve substances in plants is **the starch**, a polysaccharide accumulated in seeds, bulbs, tubercles and other organs. Generally, the processes of starch catalytic degradation have been thoroughly studied as to the digestion of this polysaccharide by the animal organisms. However, in the vegetal tissues, catalytic degradation of starch is performed at variable rates, especially during the multiplication period. Similarly with the case of animal organisms, in plants, starch degradation is performed mainly through hydrolysis and phosphorolysis, under the action of **amylase** and, respectively, α-glucanphosphorylase (DUMITRU, 1980; TĂNASE *et al.*, 2000).

From practical reasons, the amylolytic enzymes of vegetal origin have been more intensely studied for culture plants and less for those belonging in the spontaneous flora (CIORNEA *et al.*, 2005; 2006 a; 2006 b).

Material and methods

The experiments have been developed on seeds of *Setaria glauca*, *Festuca drymeia* and *Bromus japonicus,* harvested in the summer of 2005 and stored in suitable conditions up to the moment of their utilization.

Prior to their introduction into Petri plates, the seeds have been treated with 3% oxygenated water, thus avoiding samples’ contamination with rots, which might have altered the results. Further on, they were washed with distilled water, divided into reference groups, as a function of their species, and introduced into Petri plates for germination, the samples being taken over at 24 hours intervals.

The activity of total amylase was determined by the Noelting - Brenfeld method, the results being expressed as micromoles maltose / g (ARTENIE *et al.*, 1981). Three parallel determinations were made for each sample, a statistical analysis of the

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experimental results obtained being finally developed (FOWLER *et al.*, 2000).

Results and discussions

A first objective in the determination of total amylase's activity in the species taken into study was plotting of the standard curve for converting the extinction units (Fig. 1).

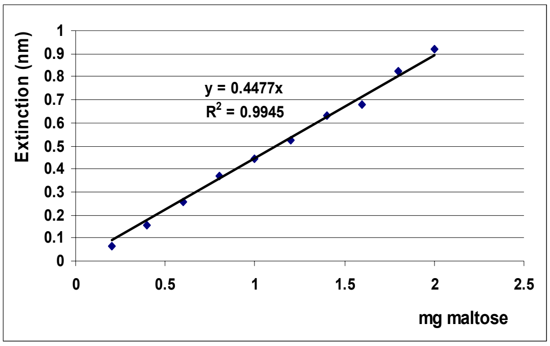

Fig.1 - Standard curve for dosing of maltose

On the basis on the graph, the regression straight line was plotted and the regression equation of the straight line was calculated. According to this equation, the amounts of maltose corresponding to the samples under analysis were subsequently established. All values were reported to the amount of tissue employed (µM maltose / g).

As to the activity of total amylase in *Setaria glauca*, the results attained evidence its significant increase from one germination day to another. Thus, the enzymatic activity takes values of 105.236 µM maltose / g in the first germination day, the maximum value - 786.229 µM maltose / g - being recorded in the sixth germination day.

After this period, the activity of total amylase progressively decreases (from 421.977 µM maltose / g at 192 hours of germination up to 83.457 µM maltose / g at 240 hours of germination) (Fig. 2).

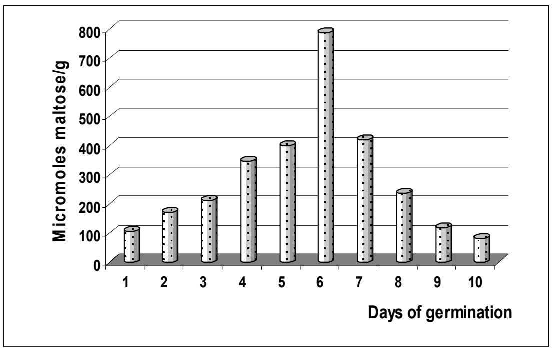

Fig.2 - Absolute activity of total amylase in germinated caryopses of *Setaria glauca*

The activity of total amylase as a function of the germination time was comparatively illustrated by graphical plotting of the percent values of the enzymatic activity (Fig. 3), the available data evidencing a directly proportional increase of the total amylase in the first germination days, followed by a considerable increase after 144 germination hours.

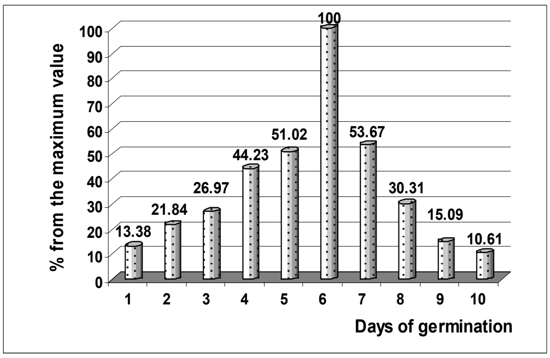

Fig.3 - Relative activity of total amylase in germinated caryopses of *Setaria glauca*

Starting from the average value and from standard deviation for all samples under analysis, the upper and lower limits of the variability intervals have been subsequently calculated on the basis of the critical value, *t* (α, n-1), given by de α = 0.05 and n-1 degrees of freedom, *i.e.* *t* (0.05, 11), as synthesized in Fig. 4.

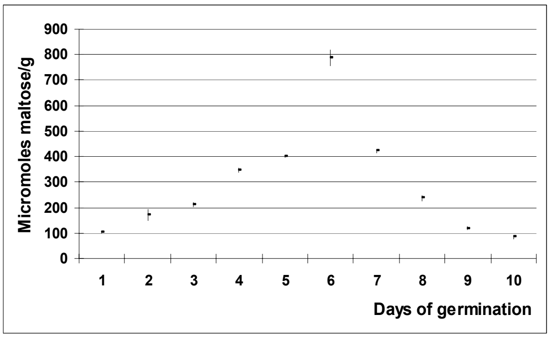

Fig.4 - Confidence intervals of the activity of total amylase in *Setaria glauca*

In *Festuca drymeia*, the amylasic activity is minimum in the first day of the experiment (its average value being of 181.50 µM maltose / g). As also evidenced by the graphical representation, the absolute activity of total amylase records a slow increase in the first six days, followed by a sudden increase of the enzymatic activity (*i.e.* from an average value of 609.00 µM maltose / g to an average value of 1762.50 µM maltose / g) in the seventh day. After this increases, the amylasic activity decreases in the eighth day, (*i.e.*, from an average value of 1762.50 µM maltose / g to an average value of 882.00 µM maltose / g), other decreases being recorded, too, in the other days of the experiment (Fig. 5).

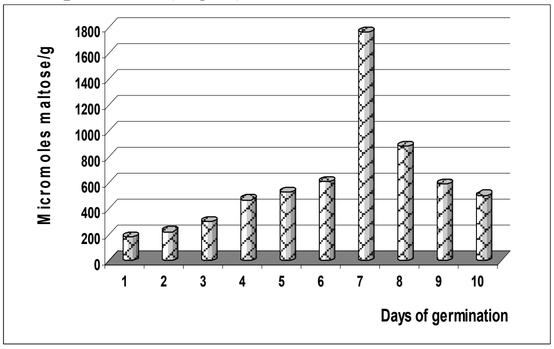

Fig.5 - Absolute activity of total amylase in germinated caryopses of *Festuca drymeia*

For a better understanding of the enzymatic activity, the percent values were calculated and graphically plotted (Fig. 6).

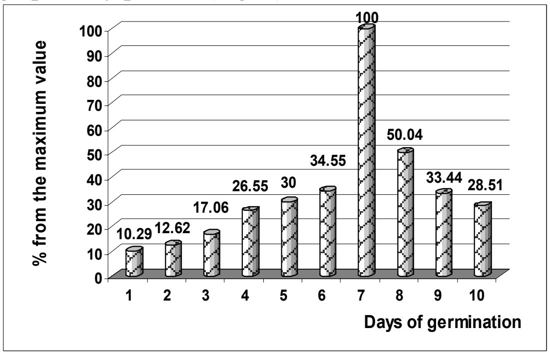

Fig.6 - Relative activity of total amylase in germinated caryopses of *Festuca drymeia*

As to the limits of the confidence intervals of the activity of total amylase in the germinated caryopses of *Festuca drymeia*, they are extremely narrow for all samples under study (Fig. 7).

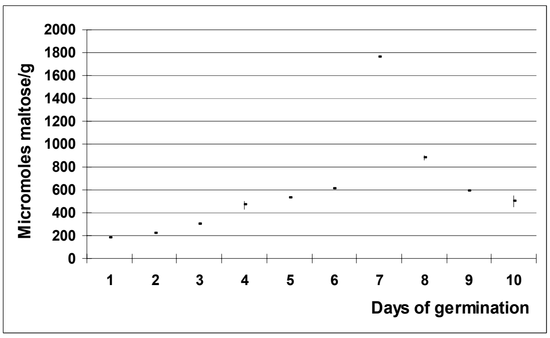

Fig.7 - Confidence intervals of the activity of total amylase in *Festuca drymeia*

The experimental results concerning the amylasic activity of *Bromus japonicus* also evidenced a minimum value, starting, again, from the first germination day (146.50 µM maltose / g).

One may see that the absolute activity of total amylase records a slow increase in the first seven days, followed - in the 8th day - by a sudden increase of its activity (862.50 µM maltose / g), representing the maximum enzymatic activity, after which a slow decrease is to be recorded in the last 2 days of the experiment (Figs. 8 - 9).

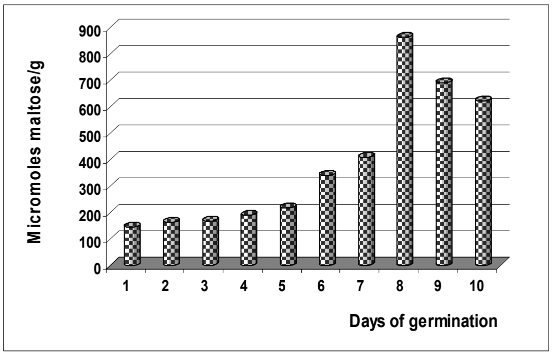

Fig.8 - Absolute activity of total amylase in germinated caryopses of *Bromus japonicus*

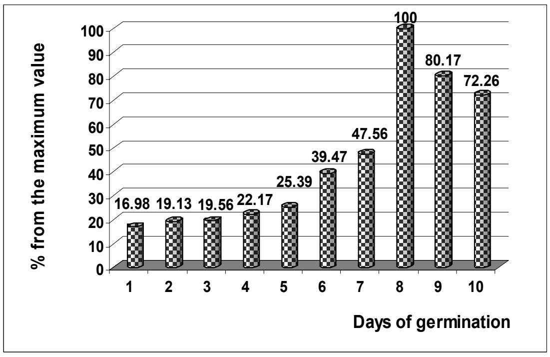

Fig.9 - Relative activity of total amylase in germinated caryopses of *Bromus japonicus*

The limits of the confidence intervals are, once again, extremely narrow, which indicates an extremely low degree of error (Fig. 10).

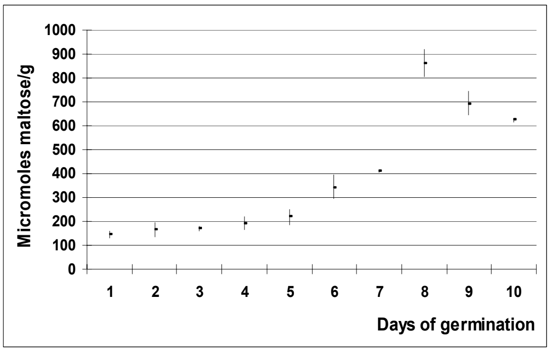

Fig.10 - Confidence intervals of the activity of total amylase in *Bromus japonicus*

To check the possible differences or similarities in the activity of total amylase for all the three species of spontaneous graminaceae considered in the study, **the bifactorial model I ANOVA test** - with an equal number of observations in the cell - was applied (FOWLER *et al*., 2000).

This test permitted calculation of the square sums, on the basis of the variability sources (on columns, rows, of the internal and total interaction), of the factors' values (on columns, rows and of the interaction), as well as their critical values.

The results of the test evidenced that both factors - *i.e.*, the species and the germination time - influence the enzymatic activity, although to a different extent (Fig. 11).

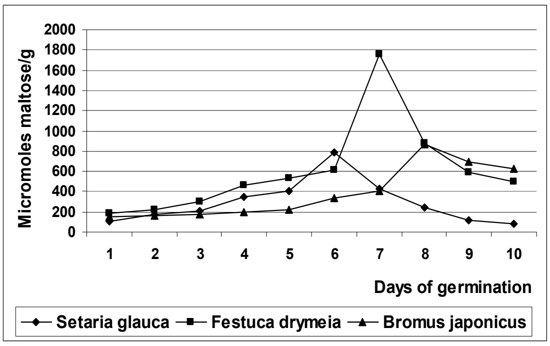

Fig.11 - Comparative representation of the activity of total amylase in the species under study

Conclusions

1. In all species under analysis, the activity of total amylase follows the same curve, an ascending one in the first germination days, with a maximum value attained in the 6th, 7th and, respectively, 8th day, after which a progressive decrease is to be noticed.

2.The limits of the confidence intervals are extremely narrow for all samples subjected to analysis.

3. Statistical analysis of the experimental data evidences some differences in the amylasic activity, induced - on one side - by the species and - on the other - by the germination time.

Rezumat

Pentru realizarea părții practice a acestei lucrări s-au folosit cariopse germinate aparținând la trei specii de graminee spontane din familia *Poaceae*. Germinarea cariopselor s-a realizat în plăci Petri căptușite cu hârtie de filtru umezită cu apă distilată, recoltarea probelor făcându-se din 24 în 24 de ore. Rezultatele experimentale obținute evidențiază existența unor diferențe privind activitatea amilazică pe de o parte în funcție de specie, iar pe de altă parte în funcție de timpul de germinare.

References

1. ARTENIE V., TANASE E., 1981 - *Practicum de biochimie generală*. Ed. Univ. „Al. I. Cuza" Iaşi, 94 - 99.
2. BODEA, C., 1984 - *Tratat de biochimie vegetală*,. Vol. 5, Ed. Didactică şi Pedagogică, Bucureşti, 278 - 281.
3. CIORNEA E., COJOCARU, D.C., VASILE, G., 2005 - *Some preliminary data on the activity of total amylase, α- and β-amylase in the small roots and strains of millet and bristle grass*. Studii şi Cercetări, Biologie, Serie nouă, Nr. 10, Universitatea Bacău, Ed. Univ. din Bacău, 161 - 163.
4. CIORNEA E., COJOCARU, D.C., VASILE, G., 2006 a - *Studiul unor enzime implicate în metabolismul glucidic în semințele germinate la unele graminee cultivate şi spontane*. Lucrări ştiințifice, Seria Zootehnie, Vol. 49, U.S.A.M.V. Iaşi, Ed. „Ion Ionescu de la Brad" Iaşi, 40 - 47.
5. CIORNEA E., ARTENIE V., COJOCARU, D., VASILE G., 2006 b - *On the activity of α-amylase in some culture and spontaneous graminaceae, during their germination period*. An. Şt. Univ. „Alexandru Ioan Cuza" Iaşi, s. II a Genetică şi Biologie Moleculară, Tom VII, Fasc. 1, 37 - 41.
6. DUMITRU, I. F., 1980 – *Biochimie*. Ed. Didactică şi Pedagogică, Bucureşti, 286 - 288.
7. FOWLER J., COCHEN L., JARVIS P., 2000 - *Practical statistics for field biology*. Second Edition, Ed. by John Wiley & Sons, Ltd., England, 186 - 207.
8. TĂNASE E., COJOCARU D.C., GODJA A., CIORNEA E., 2000 - *Researches on the mobilization of glucides from cereal seed during germination*. An. Univ. „Al. I. Cuza", Iaşi, Tom XLVI, 203 - 207.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 208 – 212

ON THE ACTIVITY OF SOME ENZYMES INVOLVED IN THE MOBILIZATION OF THE RESERVE SUBSTANCES OF *ZEA MAYS* DURING GERMINATION

ALEXANDRU VALENTIN NEAGU*, ELENA CIORNEA*, GABRIELA VASILE*, DUMITRU COJOCARU*

ABSTRACT

NEAGU A. V., CIORNEA E., VASILE G., COJOCARU D., 2006 – On the activity of some enzymes involved in the mobilization of the reserve substances of *Zea mays* during germination. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 208-212.

The paper discusses the dynamics of the activity of total amylase, of starch and protein concentration in three different sorts of maize (*Zea mays*): Horse tooth, Everta and Cincantin, as well as of the acid and alkaline lipase in the Horse tooth sort, during the germination period.
The activity of the enzymes taken into study demonstrates that the main reserve substances are mobilized at high rates in the first days of the germination process, after which a decrease in their activity - probably caused by the ever more ample biosynthetic processes, as well - is to be recorded.

Key words: germination, *Zea mays*, total amylase, lipase

Introduction

The process of plant's multiplication has always aroused a special interest from the part of the researchers, eager to elucidate the biochemical and physiological aspects related to the mobilization of the nutritive substances from seeds, tubercles etc., and, equally, to the way in which the new plants use them. The process is an extremely complex one, involving both internal and external factors. To the former category, one should mention as belonging the morphological integrity of seeds and tubercles and an optimum content of nutritive elements, while the external factors include the conditions provided by the soil, such as: humidity, temperature, mineral salts, the acid-base balance etc. (BURZO *et al*., 2005).

As a general rule, from a biochemical perspective, the germinal process assumes the mobilization of the reserve substances - which is attained through the hydrolysis of proteins, polysaccharides and lipids, under the action of some specific enzymes, up to the basic structural elements of theirs (aminoacids, monosaccharides, fatty acids etc.) - although their utilization as precursors in the metabolic processes assures plantlet's development up to the initiation of the photosynthetic process (NEAMŢU *et al*., 1993; OSAN, 2004).

Material and methods

In the experiments, seeds of *Zea mays* from the Horse tooth, Everta and Cincantin sorts – previously washed with distilled and oxygenated water and then put into Petri plates lined with filter paper impregnated with distilled water - were employed, samples' taking over being performed at interval of 24 hours.

The activity of total amylase was determined by the Noelting - Brenfeld method, the lipase - by the tritimetric method, as depending on the increase of the incubation medium's acidity resulting from the release of the fatty acids from the triacylglyceroles employed as a substrate, the starch - by the polarimetric method, while protein concentration was calculated by the Lowry method (ARTENIE *et al*., 1981; COJOCARU, 2005).

For each sample in part, three parallel dosings have been made, the data under discussion representing the mean values of such repetitions.

Results and discussions

A first step in the determination of the activity of total amylase involved plotting of the standard curve for the conversion of the extinction units (Fig. 1).

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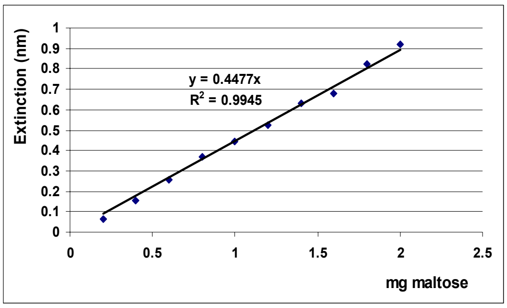

Fig.1 - Standard curve for dosing of maltose

On the basis on the graph, the regression straight line was plotted and the regression equation of the straight line was calculated. According to this equation, the amounts of maltose corresponding to the analyzed samples have been subsequently established, all values being reported to the amount of tissue employed (µM maltose / g).

In a following stage, seed's germination capacity was determined. To this end, a predetermined number of seeds have been germinated, under identical conditions, for all the three sorts. After their germination, the seeds have been counted, their number being subsequently reported to the total number of seeds and expressed as percentage values. For the germinated seeds, protein concentration was also determined, on considering the role they play - especially the protein -enzyme macromolecules- in the germination process.

As evidenced by the data listed in Tab. 1, a certain differentiation should be noticed, as to their germination degree and protein concentration, between the 3 varieties involved.

Tab. 1 - Germination degree and average protein concentration in various *Zea mays* sorts

	Horse tooth	Everta	Cincantin
Germination degree (%)	94	93	65
Protein concentration (mg/g)	74.5	62.5	54

The highest germination degree (94%) was recorded for the Horse tooth sort, followed by Everta (93%), the lowest values (65%) being noticed for the Cincantin sort. Also, the highest protein concentration (74.5 mg/g) is registered for the Horse tooth sort, while the value recorded for Everta was of 62.5 mg / g, the lowest one, of 54, being recorded for the Cincantin sort (Fig. 2).

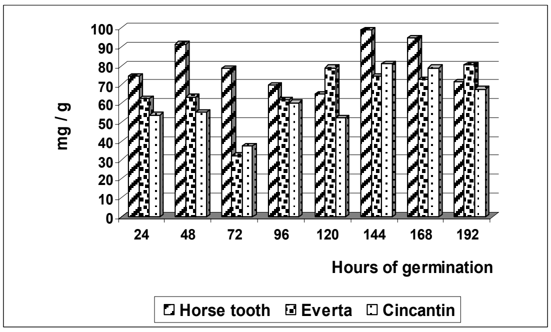

Fig.2 - Protein concentration (in mg / g) in different sorts of maize during germination

The literature data of the field show that, in the case of maize, the main reserve substances are the polyglucides (the starch) and the lipids. In the germinal process, the polysaccharides are mobilized for providing the glucose necessary in the biochemical and physiological processes specific to germination. The mobilization of starch may be made in two different ways, namely: through hydrolysis, under the action of amylases, and through phosphorolysis, under the action of α-glucanphosphorylase. The total amylase activity may provide precious pieces of information on the rate at which the starch is hydrolyzed, a process in which glucose - subsequently used as an energy source - and metabolic precursors for biosynthetic processes, are formed (ARTENIE *et al.*, 1999; VOET *et al.*, 2005; CIORNEA *et al.*, 2006).

In the Horse tooth sort, a decrease in the activity of total amylase is recorded in the first 72 hours, from 66.3 µM maltose / g to 32.8 µM maltose / g, followed by a increase of their activity, the maximum being recorded at 120 hours from the beginning of germination (83.9 µM maltose / g). Later on, a new decrease of activity is to be recorded, up to 57.1 µM maltose / g, at 192 hours from the beginning of germination (Tab. 2, Fig. 3).

Tab. 2 - Total amylasic activity in the Horse tooth sort

Nr. crt.	Germination hours	µM maltose / g	% of the maximum value
1	24	66.3	79.02
2	48	51.9	61.85
3	72	32.8	39.09
4	96	74.3	88.55
5	120	83.9	100
6	144	82.7	98.56
7	168	78.4	93.44
8	192	57.1	68.05

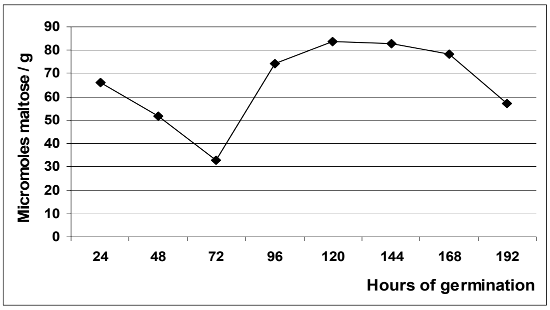

Fig.3 - Dynamics of the absolute activity of total amylase in the seeds of the Horse tooth sort during germination

As to the Everta sort, the maximum in the activity of total amylase, recorded 48 hours from the beginning of germination, attains a value of 113.8 µM maltose / g, which is followed by a decrease up to a value of 19.8 µM maltose / g, recorded after 144 hours (Tab. 3. In the following 24 hours, a slight increase of activity - up to 21.9 µM maltose / g - is to be recorded, the value registered after 192 hours from the beginning of germination being of 11.6 µM maltose / g. Unlike the Horse tooth sort, the Everta one attains its maximum activity more quickly, the value being also higher (113.9 *versus* 83.9 µM maltose / g) (Fig. 4).

Tab. 3 - Total amylasic activity in the Everta sort

Nr. crt.	Germination hours	µM maltose / g	% of the maximum value
1	24	30.4	26.71
2	48	113.8	100
3	72	58.4	51.31
4	96	43.9	38.57
5	120	30.7	26.97
6	144	19.8	17.39
7	168	21.9	19.24
8	192	11.6	10.19

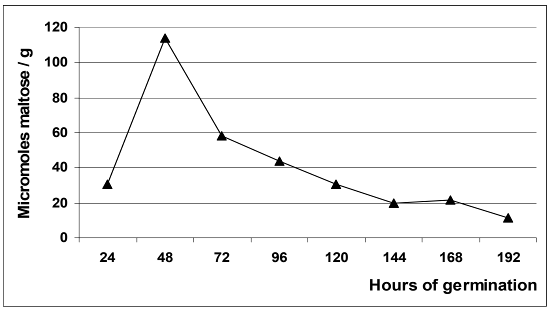

Fig.4 - Dynamics of the absolute activity of total amylase in the seeds of the Everta sort during germination

In the Cincantin sort, the values recorded decrease from 56.6 µM maltose / g, recorded at 24 hours, up to 31.4 µM maltose / g - 48 hours from the beginning of germination, attain a maximum of 104.5 µM maltose / g after 72 hours and then decrease - first to 81.5 µM maltose / g (96 hours) and then to 42.7 µM maltose / g (120 hours). There follows a gradual decrease, up to 22.4 µM maltose / g, 192 hours after the beginning of the germinal process (Tab. 4).

Tab. 4 - Total amylasic activity in the Cincantin sort

Nr. crt.	Germination hours	µM maltose / g	% of the maximum value
1	24	56.6	54.16
2	48	31.4	30.04
3	72	104.5	100
4	96	81.5	77.99
5	120	42.7	40.86
6	144	32.8	31.38
7	168	27.1	25.93
8	192	22.4	21.43

Comparatively with the Horse tooth sort, the Cincantin one evidences, in the first 48 hours, a similar amylasic activity, which records decreasing values up to 72 hours, when the maximum value is attained; in the case of the Horse tooth sort, the maximum is recorded later, *i.e.*, at 120 hours, its value being lower than that of Cincantin (83.9 *versus* 104.5 µM maltose / g); after attaining their maximum, both sorts record a decrease in their amylasic activity. Comparatively with the Everta sort, in which the maximum activity, of 113.8 µM maltose / g, is recorded at 48 hours, the Cincantin sort records its maximum - which is of 104.5 µM maltose / g - 72 hours after the beginning of germination (Fig. 5).

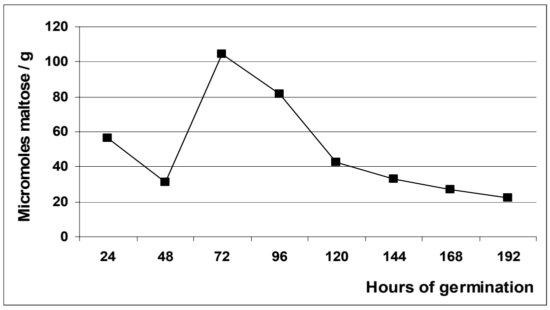

Fig.5 - Dynamics of the absolute activity of total amylase in the seeds of the Cincantin sort during germination

Unlike the Cincantin sort, in which, after the attainment of the maximum, a continuous decrease of the values is to be recorded, in the case of Everta, a certain increase is noticed 168 hours from the beginning of germination, followed by a decrease (Fig. 6).

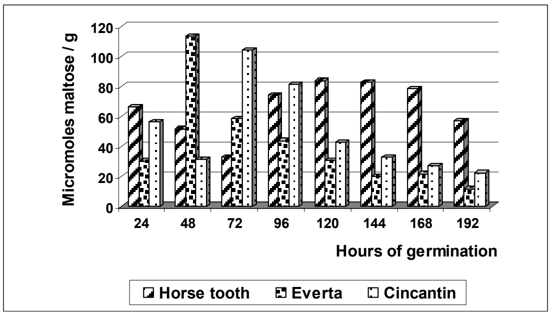

Fig.6 - Dynamics of the absolute activity of total amylase in the maize seeds of various sorts during germination

In the Horse tooth sort, at 24 hours from the beginning of the germinal process, the starch concentration is of 49.2 mg%, gradually decreasing - during the germination - up to 16.9 mg% at 192 hours. A difference of 32.3 mg% is to be noticed between the initial value of the starch content and the one determined at 192 hours from the beginning of germination.

In the case of Everta, at 24 hours from the beginning of the germination process, the starch content is of 81.4 mg%, gradually decreasing up to a minimum value of 51.2 mg%, recorded at 192 hours. The difference between the 2 values is of 30.2 mg%, lower than in the case of the Horse tooth sort.

In the Cincantin sort, the initial value of the starch content is of 63.5 mg%, which gradually decreases up to 28.4 mg% at 192 hours from the beginning of germination. The difference between the values of the starch content recorded in the beginning and, respectively, in the end of the germination process is of 35.1 mg%, representing the highest difference recorded in the three sorts under study (Fig. 7).

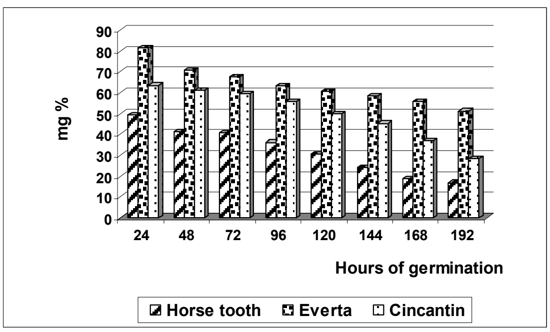

Fig.7 - Starch concentration (in mg%) in various sorts of maize during germination

As already discussed, the mobilization of starch - acting as a reserve polyglucide - is closely inter depending on the total amylasic activity, even if some differences could be observed among the sort subjected to analysis as to the dynamics of the enzymatic activity. That is why, it was only the Horse tooth sort taken into study as to the dynamics of the content of total lipids and of the lipasic activity, during germination, for a better understanding of the process of neutral lipids (triacilglycerols) mobilization during germination.

In the beginning of the germinal process, the activity of alkaline lipase records a value of 149.5 ml/100 g seeds, while the acid lipase records a value of 24.3 ml/100 g seeds.

48 hours after the beginning of the germinal process, a rapid increase in the activity of the alkaline lipase - up to a value of 233.6 ml/100 g seeds - is to be recorded, the acid lipase increasing up to 74.4 ml/100g seeds.

At 72 hours from the beginning of germination, the activity of the alkaline lipase progressively increases, up to 483.4 ml/100 g seeds, while, within the same time interval from the beginning of germination, the acid lipase records a value of 76.0 ml/100 g seeds, which is actually the maximum value ever recorded.

Following other 48 hours, the activity of the alkaline lipase attains the maximum value of the germinal process, *i.e.*, 545.5 ml/100 g seeds.

96 hours after the beginning of germination, the activity of acid lipase progressively decreases, up to a value of 55.8 ml/100 g seeds, while the value recorded after 192 hours is of 18.3 ml/100g seeds.

At 144 germination hours, the alkaline lipase begins to gradually decrease, a value of 420.7 ml/100g seeds being attained after 192 hours of germination (Figs. 8 - 9).

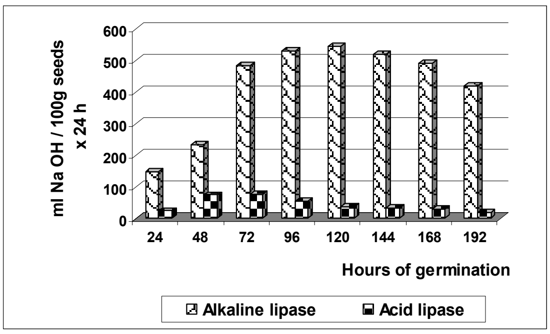

Fig.8 - Absolute activity of alkaline and acid lipase during germination in the Horse tooth sort

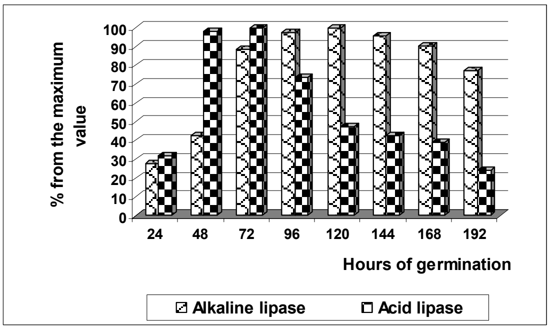

Fig.9 - Relative activity of alkaline and acid lipase during germination in the Horse tooth sort.

Conclusions

1.The activity of total amylase attains its maximum value in the beginning of the germination period in the Everta and Cincantin sorts, while, in the case of the Horse tooth sort, the maximum is attained somehow later, while a high amylasic activity is maintained over a longer time.

2.As to the activity of acid and alkaline lipase, it records a progressive increase in the first 3 and, respectively, 5 germinations days, after which it progressively decrease.

3.The activity of the enzymes taken into study demonstrates that the main reserve substances are mobilized at high rates in the first days of the germination process, after which a decrease in their activity - probably caused by the ever more ample biosynthetic processes, as well - is to be recorded.

4.Regarding the activity of total amylase, no direct correlation of it with the dynamics of starch concentration could be established, at least for the time being. A possible explanation might be the fact that starch degradation may occur both hydrolytically, under the action of amylases, and phosphorolytically, under the action of α-glucanphosphorylase.

Rezumat

Lucrarea prezintă rezultatele cercetărilor asupra dinamicii activității amilazei totale, concentrației amidonului şi proteinelor la trei soiuri de porumb (*Zea mays*): Dinte de cal, Everta şi Cincantin cât şi a lipazei acide şi alcaline la soiul Dinte de cal în timpul germinației.

Activitatea enzimelor luate în studiu demonstrează că principalele substanțe de rezervă sunt mobilizate cu viteză mare în primele zile ale procesului germinativ, după care se înregistrează o scădere a activității acestora cauzată, probabil, şi de procesele biosintetice care iau amploare.

References

1. ARTENIE VL., TĂNASE E, 1981 - *Practicum de biochimie generală*. Ed. Univ. „Al. I. Cuza”, Iaşi, 94 - 99.
2. ARTENIE VL., ARTENIE R., 1999 - *Introducere în metabolismul lipidelor*. Matrix Rom, Bucureşti, 2 - 19.
3. BURZO I., DOBRESCU A., 2005 - *Fiziologia plantelor de cultură*. Vol. II, Elisavaros, Bucureşti, 10 - 21.
4. CIORNEA E., COJOCARU D.C., VASILE G., 2006 - *Studiul unor enzime implicate în metabolismul glucidic în semințele germinate la unele graminee cultivate şi spontane*. Lucrări ştiințifice, Seria Zootehnie, Vol. 49, U.S.A.M.V. Iaşi, Ed. „Ion Ionescu de la Brad” Iaşi, 40 - 47.
5. COJOCARU D. C., 2005 - *Enzimologie practică*. Tehnopress, Iaşi, 205 - 207, 426 - 429.
6. NEAMȚU G., CÂMPEANU GH., SOCACIU CARMEN, 1993 - *Biochimie vegetală*. Ed. Didactică şi Pedagogică, Bucureşti, 110 - 117.
7. OSAN AL., 2004 - *Biochimie: procese metabolice*. University Press, Târgu-Mureş, 85 - 92.
8. VOET D., JUDITH G., PRATT CHARLOTTE W., 2005 - *Fundamentals of Biochemistry Life at the Molecular Level*. Second Edition, 214 - 222.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 213 – 216

BACKGROUND REGARDING THE VEGETABLE AND MEDICINAL SIGNIFICANCE OF HERBS FROM SPONTANEOUS FLORA

MARGARETA ORDEAN*,
VICTOR POPESCU**, RUXANDRA CIOFU**

ABSTRACT

ORDEAN M., POPESCU V., CIOFU R., 2006 - Background regarding the vegetable and medicinal significance of herbs from spontaneous flora. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 213-216.

Due to its geographical position and its pedoclimatics conditions, Romania has one of the most variety flora of the European Continent. It contains over 3600 species superiour and culture spontaneous plants, over 5000 were named by aou ancestors and 10-12 % are used in Romanian scientific and traditionale medicine.

Present document contains partialy resultsaf this this study made in 2003, presenting a background of researches regarding vegetable and medicine importance of spontaneous flora.

The presence of a high species number from different country areas and preponderant from Danubes Delta in botanics colection of" Danubes Delta Museum"-Tulcea, required this study through corelation between scientific study and museum study.

This species counting 140000, may have many usabilities: medicinal, vegetable contimantation, aromatic, fodder, ornamental, tinctorial use, etc.

Key words: herbs, medicinal, spontaneous flora

Introduction

It was specified that in the specialized literature, Romania, due to its geographical position and its pedoclimatics conditions has specific and one of the most varied of the european continent.; the flora contain over 3600 species of higher spontaneous and cultured plants, but 10-12 % are useful in the romanian scientific and traditional medicine.

From this high number of speciesof the spontaneous romanian flora, just 140 plants are edible.It is affirmed as a result of bibliographical study that only 70% from edible plants are used in alimmentation, that means half of those used by the romanian peasants half century ago (DRAGULESCU,1991).

Compared with the Romaniam flora, the Danube Delta`s flora is very reach and very varied and it is hard to imagine how on a small teritory, wich represents 1.45% of Romania, there are 1/3 from total number of known species in our flora.

As it is told in the work: „Danube Delta` flora", in the delta are 955 of spontaneous cormofits, plus 64 subspecies, number wich may grow up with human help but wich can also decrease due o profound biotops modification (CIOCARLAN, 1994).

Delta Danube`s cormofits flora preocupated many researchers, knowing over 300 works wich contains different herbs classes: of bogs, of water, of lawns, wooden plants,important plants for pisciculture fish breeding, sands` plants etc.,but no works regarding vegetable and medicinal herbs.

The last have a great importance, being studyed in antiquity and in our days too. Information about the usability of spoantaneous flora herbs in alimentation and also in herbs medicine exists since the beginning of human evolution .Human being learned to cultivate a lot of plants but never renouncing gathering the spontaneous ones, wich proved to be a valuable and important raw material in every day food preparing.In this way it becomed a tradition cooking different foods with spoantaneous plants.

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After a period when the scientific progresses of modern science weren`t do anything just confirming empirical notions of the past, the usability of spontaneous herbs flora in medicine and also in vagetable domain took proportions in our days.

Present researches help a study regarding spontaneous species with vegetable and medicine value from Danubes Delta.

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The presence of a high species number from different country areas and preponderant from Danubes Delta in botanics colection of ”Danubes Delta Museum”-Tulcea, required this study through corelation between scientific study and museum study.

This species counting 140000, may have many usabilities: medicinal, vegetable, contimantation, aromatic, fodder, ornamental, tinctorial use, etc.

We are considering this interdependence study started in our case from practice in botanics colection of the museum of medicinal and vegetable herbs, wich were studiedand after corelated with informations in the areas where were made personal researches.

As a result of this researches we can say that is necessary returning at the traditional herbs usabilities from a retrolocical point of view, in order not be putting in danger respectives species.

Background regarding the vegetable significance of herbs from spontaneous flora

Vegetable herbs are those edible herbs, whose organs we can use (for exemple: roots, leaves,burgeons, tubs stems,hipertrofiates inflorescence, bulbs,young shoots, fruits), wich can be eated green, prepared, pickled, or conserved, assuring, to the human body, high quantyties of biocatalyser substances:vitamines, enzymes, hormones,volatile substances, mineral elements. The edible parts are named „vegetables”. This represents the main source of vitamines assuring 80-95% from the necessary of C vitamine, 60-80%of A vitamine, 20-30% of B vitamine, 90-100% of P vitamine, and also a good part of K and E vitamines (COIFU, 2003).

Vegetables are reach in minerals salts, salts of Ca, P, Fe, K, MG, S, Cl, Zn,Cu, etc., with great significance for the human body.Vegetable herbs help through carbon hidrates and albumine, assuring the human body the necessary fibres (POPESCU,1996).

Informations about using herbs from spontaneous flora we have since the beigining of human evolutio. The plants eaten by ours ancestors were differents roots, bourgeons, leaves, muchrooms, etc,.As a proof there are a lot of written sources, wich reminds of consuming *Rumex acetosa* L.(sorrel), *Althaea absinthium* L., *Malva sylvestris* L (round dock), etc.

Untill bringing salad (*Lactuca sativa* L) and spanach (*Spinacia oleraceea* L.) from Small Asia ,round dock (*Malva sylvestris* L.) it was in Europe near good-king-Henry (*Chenepodium bonus-henricus*), a very important vegetable.

Greek ancient written and latin inform about using thorns young shoot (*Ruscus aculeatus* L.)and rabbit bone (*Ononis hiricina* L.), minta (*Mentha pulegium* L) and wormwood (*Artemisia absinthium* L.), wich Cesar` soldiers were eating in combination with milk.

Another plant belonging to spontaneous flora apreciated by romans, greeks and etiopians as vegetable is the amaranth (*Amaranthus* sp.). From its seeds it was obtained a flour used to make bread.The dacians used also this flour in traditional medicine.Geto dacians used nettles (*Urtica dioica* L.), roadweed (*Plantago major, Plantago lanceolata* L.),wild thyme(*Thymus vulgaris* L.), camomile (*Matricaria perforata* Merat, *Matricaria millefolium*). They were used in alimentation and medicine (DRAGULESCU, 1991).

Ater conquering Dacia the romans brought the contribution regarding the divercity of vegetables. First vegetables gardens appeared near monasteryes and landowner yards. Thus Jesuit monk Bandini who visited Moldova during the reign of Vasile Lupu (1634-1635) wrote”at the Bistrita Monastery vegetables fruits and herbs were the main monks` food (CIOFU,2003).

Becoming cultivator, man renounced a part of herbs, his food was based now only on culture species, wich were a rich source of amidon and proteines.

The main motifs of renouncing at the vegetable herbs of spontaneous flora were: culture of different species and the fact those ones were easyer to procure. Because of that and started the process of losing informations about wild herbs.

As a result,in XVIII century ,there were introduced in culture new species of vegetables like: pepper (Capiscium tuberosum L.),potato (Solanum tuberosum L.), eggplant (Solanum melongena L.), tomato (Lycopersicon esculentum Mill.), clove (Dianthus chienensis L.),rosemary (Rosmarinus officinalis L.) etc.This plants were used as exchange between Ardeal and Tara Romaneasca .

In Transilvania, in 70` , same century, were used: spanach (*Spinacia oleracea* L.), cauliflower (*Brasica oleracea* L.), artichoke (*Scolymus hispanicus* L.), turnip cabbage (*Brassica oleracea* (L.) Miller.), beet (*Beta vulgaris* L.), radish (*Raphanus sativus* L.), asparagus (*Asparagus officinalis* L.), garden cress (*Nasturtium officinale* (L.), brown fallow (*Apium graveolens* L.), sorrel (*Rumex acetosa* L.), salad (*Latuca sativa* L.), chicory (*Cichorium intybus* L.), wormwood (*Artemisia absinthium* L.), etc (VALNET, 1987).

The peasants didn`t fortget vegetables plants of spontaneous flora. Thei resorted to them in case of starvation, war, or in spring when there wasn`t any source of cultivated plants.

„Thus the chronicles say , between 1815 - 1817 there was in Transilvania a cruel starvation(...), fact that obliged poor people eating different plants: amaranth, orach, priks, hart`s tongue, sorrel, colt`s food and anothers herbs , that were boiled and acidified with apples or with something else"(DRAGULESCU,1991).

In Moldova and Tara Romaneasca in time of starvation people were eating club rush roots or thistle, all winter long.

In our days the importance of herbs from spontaneous flora took proportions. Many researchers like:biologists, holticulturists, doctors are studying today this herbs. Fruits and vegetables like:borage (*Borago officinalis* L.), round dock (*Malva silvestris* L.), chicory (*Cichorium intybus* L.), asparagus (*Asparagus officinalis* L.), wilde thyme (*Thymus vulgaris* L.), caraway (*Carum carvi* L.) etc.

The vegetables are used in therapeutic ways fact that offer them a great importance. The Romanian Departaments of Horticulture emphasyze also the significance of herbs wich the specialists research and diffrent works about vegetables are elaborated .

There are only 140 alimentary plants comming from spontaneous flora of Romania, but there are used only aproximatively 70 plants, meanning half of the herbs the peasants were using half century ago (DRAGULESCU, 1991).

The background of researches regarding spontaneous flora herbs medicinal importance

Vegetables world is one of the oldest concerns of people. Healing wounds, was also a result of spontaneous flora plants descovery. Since Burebista days geto-dacians started to find out the significance of herbs. (CRACIUN, BOJOR, ALEXAN,1976).

The firsts information regarding using plants by ours ancestors belong the greek doctor Dioscoride(Dioscorides sau Dioskurides) born in Small Asia in first year our era. Because he was taking part in Nero`s army he traveled a lot not only in roman lands but in Dacia too, and he learned many things medicinal plants.

Dioscordie put all the informations in a consisting work written in greek, named „Ways of Healing", published in 77 our era. In the book he describes almost 600 medicinal plants, represented in draws too. In the same work Pedanios Dioscordie from Anazarba emphasize the fact that in Dacia were used on a large scale the plants based on same external caracteristics, in number of 40 (42 say same researchers)names of dacians plants, but also romans and greeks names.

The presence of dacians naming is not random but it is strongly bound of useful demands even economic ones, because due to its profile the work was an important guide for another physicians and diffrent people: comerciants, sellsmen who sold medicinale herbs in Roman Imperium and in neighbourhood , where romans were making trade and goods exchanges (BOJOR, ALEXAN,1984).

Thus we can say that traditional medicine, based on healing herbs, must being taken a great place in spiritual and religious life of geto – dacians.

The knowledges regarding using medicinale plants in diffrent diseases treatment pased over generations untii our days underlining our medicinal flora represents a great and distinct importance not only through its high number of species but quality is a good motif to remember. Quality means all the substances plants contains,and their therapeutic action too.

Starting with XIX century, our medicinale plants, due to those qualities were very appreciated all over the foreign markets. The whole stock of vegetables products was made from tinctures and extracts.

„It is said in the first romanian edition of pharmacopoeia (1862), there are 217 vegetables products, but 102 can be obtained from the herbs growing in our country. This products were well paid until little time after the Second World War.There were cases when products were taken by foreign companies at cheap prices which only packed them up. In this period our country population trusted medicinale herbs,and used and kept them untill present." (FISCHER, 2002).

Medicinale herbs become a state issue started with 1949,when were created research instituts in order to value them.Due to its geographical position and its pedoclimatics conditions, Romania has one of the most variety flora of the European Continent. It contains over 3600 species superiour and culture spontaneous plants, over 5000 were named by aou ancestors and 10-12 % are used in Romanian scientific and traditionale medicine (CIOCARLAN, 2000; CONSTANTINESCU, HATIEGANU-BURUIANA, 1986).

In our days plants medicine has agreat importance and play a great role in preventing and healing different diseases of the human body. Plants also serve as study object for many researchers, doctors, museums, univercities, etc.

It is very important knowing plants, the ways and the corect doses of using them in different ilnesses, not to be understood that we can use medicinale plants in a empirically way, fact that may have consequences over floristic patrimony.

References

1. AZAMFIREI L., 2003 - *Is Good to Know,* Life and health Publishing house, Bucharest.
2. BOJOR O., ALEXAN M., 1981 - *Medicinal plants – source of health*, Ceres Publishing house, Bucharest.
3. BOJOR O., ALEXAN M.,1984 - *Medicinal and aromatic herbs from A to Z*, Recoop Publishing house,Bucharest.
4. BORZA Al., 1968 - *Etnobotanic Dictionary*, Academy RSR Publishing house, Bucharest.
5. BUTNARIU H., PETRESCU C., POPESCU V., 1992 - *Vegetable Growing*. Didactic and Pedagogical Publishing house R.A., Bucharest.
6. BUTURA V., 1979 - *Romanian Etnobotanics Encyclopaedia*. Scientific and Encyclopaedic Publishing house, Bucharest.
7. CIOCARLAN V., 1994 - *Danube Delta`s Flora*, Publishing house-Ceres, Bucharest.
8. CIOFU R., et all, 2003 - *Vegetable Growing Treaty*. Ceres Publishing house, Bucharest.
9. CONSTANTINESCU GR., HATIEGANU E., 1979 - *Medicinal Plants*. Medically Publishing house, Bucharest.
10. CONSTANTINESCU GR., HATIEGANU-BURUIANA E., 1986 - *Knowing medicinal plants, their therapeutic quality,and the way of using them*. Medically Publishing house, Bucharest.
11. CRĂCIUN F., BOJOR O., ALEXAN M., 1976 - *Nature`s Farmacy*. First vol., Ceres Publishing house, Bucharest.
12. CRĂCIUN, F., BOJOR, O., ALEXAN M., 1977 - *Nature`s Farmacy*. Second vol., Ceres Publishing house, Bucharest.
13. DRAGULESCU C., 1991 - *Romanian Spontaneous Flora Edible Plants*. Sport and Turism Publishing house, Bucharest.
14. DRIMBA O., 1985 - *Civilisation and Culture History*. Scientific and Enciclopaedic Publishing house, Bucharest.
15. FISCHER E., 2002 - *Medicinal Plants Dictionary*. Gemma Press Publishing house, Bucharest.
16. MOHAN GH., 2001 - *Medicinal Plants Atlas*. Corint Publishing house, Bucharest.
17. OPRIS T., 1996 - *Builders and Producers of Nature*, Forum Publishing house, Bucharest.
18. PANTU Z., 1995 - *Romanian Nation Known Plants*, Bucharest.
19. PĂUN E., 1995 - *Carpatics Health*, FJD STIL COMMERCE Publishing house.
20. PLNIVS NATRAVALIS HISTORIA - *Antiquity Enciclopaedia Knowledge*. Third vol, Polirom Publishing house, Bucharest.
21. POPESCU V., 1996 - *Growing Pants*. First vol, Ceres Publishing house, Bucharest.
22. POPESCU V., 2001 - *Growing Pants*. Second vol, Ceres Publishing house, Bucharest.
23. SĂVULESCU T., BELIDIE AL., 1956 - *Flora R.S.R.*. vol. XIII, Academy Publishing house, Bucharest.
24. TREBEN M., 1993 - *Health from God`s Pharmacy*. Huga-Print Publishing house, Bucharest.
25. VALNET J., 1987 - *Diseases Treatment throuh Vegetables, Fruits, and Cereales*. Garamond, Junior Publishing house, Bucharest.
26. *** 1972 - *Small encyclopaedic dictionary*, Romanian Encyclopaedic Publishing house, Bucharest.

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HISTO-ANATOMICAL INVESTIGATIONS OF THE VEGETATIVE ORGANS OF *OCIMUM BASILICUM* L.

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IRINA-ELENA STĂNESCU[1]

ABSTRACT

The authors underlined a few histo-anatomical aspects of the vegetative organs of the basil. The root presents a secondary structure generated by the two formative tissues: the cambium and the phellogen. The tenuous branches of the stem present a primary structure. The secondary structure appears at the thick branches. The epidermis belonging to the petiole and to the foliar blade presents tector trichomes and secretory trichomes.

Key words: *Ocimum*, cambium, phellogen, secondary structure.

Introduction

The gender *Ocimum* consists in 50-60 species, spread in the subtropical regions of Asia and Africa. In Romania, these species are cultivated in greenhouses or in the field, in different horticultural forms. These plants stimulate the digestion and give important results in the gastro-intestinal disorders. They also cure the inflammations of the respiratory organs (GUŞULEAC, 1961).

A few histo-anatomical aspects referring to *Ocimum basilicum* L. were presented in different tractates regarding the anatomy of the dicotyledons (METCALFE and CHALK, 1972, NAPP-ZINN, 1984), in different papers (RUGINĂ şi TOMA C., 1995, TOMA-GOSTIN şi colab., 2002) and in some atlases (BRAEMER L. şi SUIS, 1900; SÁRKÁNY şi SZALAI, 1964, TOMA şi RUGINĂ, 1998).

Material and method

The material under study is represented by the vegetative organs of *Ocimum basilicum* L. In order to fulfill the present study, the material has been fixed and preserved in 70% ethylic alcohol. The sections were cut with a microtome and a botanical razor. The vegetative organs were cross sectioned and then coloured with iodine green and alaun-carmine. First of all, the sections were submitted to a discoloration process, using sodium hypochlorite (20-25’), washed with acetic water and, then, distilled water. The sections were then coloured with iodine green (1’), washed with ethylic alcohol 90%, then colored with alaun-carmine and washed again with distilled water. The next stage was mounting the sections in gel.

The micrographs were performed by means of a Novex (Holland) microscope, using a Canon A95 camera.

Results and discussions

The root

At the sectioned level, the root presents a secondary structure, generated by the two formative tissues: the cambium and the phellogen.

The phellogen is formed due to some internal layers of the cortex and generates more suber regions, often unilayered, consisting in cells larger than those of the phellodermis and of the primary cortical parenchyma.

The suber (Fig. 1) consists in izodiametrical or higher cells, with less thickened walls, but strongly suberified; when the suber region is bilayered, the cells form radialy layers.

The cambium generates an external ring of secondary phloem and a massive body of secondary xylem, entirely lignified. The phloem ring (Fig. 2) is thin, formed by sieved tubes, companion cells and a few cells of phloem parenchyma. The xylem body (Fig. 3) consists in vessels of different diameters, most of them being solitaires and irregularly dispersed in the fundamental massive of libriform;

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the cells belonging to the libriform present thickened and intense lignified walls.

The axial region of the xylem body, of the central cylinder properly, is occupied by a few larger vessels, with thinner and less lignified walls; numerous cells of cellulosed or weak lignified parenchyma are presents between the vessels and at their periphery.

The stem

The tenuous branch

It has a cross shape (Fig. 4) in transverse section, so there are four prominent ribs, separated by the same number of deep furrows.

The epidermis presents izodiametrice cells, of different sizes, having a bellied external wall, thicker than the others and covered by a very thin cuticle. Here and there a few stomata are present, strongly promining above the epidermis, multicellular secretory trichomes (consisting in a basal cell, situated between the epidermal ones, a pedicel and a unicellular gland- Fif. 5) and numerous multicellular unilayered tector trichomes, located in the epidermis of the four ribs.

The cortex is thin, chlorenchymatic, formed by rounded cells; those belonging to the hypodermis present a thicker external wall. In the ribs, the first layers under the epidermis are colenchymatised.

The cortex does not end with a special endodermis.

The central cylinder follows the general shape of the cross section, presenting a big vascular bundle (Fig. 6) in each of the four ribs and 3-4 smaller vascular bundles between them; the latters present less xylem vessels and a quite thick sheath of phloem elements.

The big vascular bundles present radialy rows of xylem vessels, separated by uni- or multilayered regions of cellulosed parenchyma; the phloem consists in sieved tubes and companion cells; at the phloem's periphery appear quite thick sheaths of future mechanical fibers; at this level, the fibers present polygonal shape in cross section, but thin an cellulosed walls.

The stem has thick pith, formed by larger cells with very thin walls, which form meatus between them.

The thick branch

It presents a quite quadratic shape (Fig. 7) in cross section, with two lateral (opposed), deep furrows and other two less deep. Comparing this branch with the anterior, there have been observed some differences, as follow:

- the colenchyma presented in the ribs presents more layers;
- the internal cortex presents larger cells than the external one; the mechanical sheaths consist in fibers with weak thickened and weak lignified walls (Fig. 8);
- the phloem is still discontinuous;
- the xylem together with the medulary rows, moderately sclerified and lignified, form a continuous ring, thicker in the four ribs, so, in the biggest bundles; these bundles show the beginning of the secondary structure:
  - the primary xylem consists in vessels separated by cellulosed parenchyma;
  - the secondary xylem consists in vessels separated by libriform fibers.

The thickest branch

The cross section has a quadratic to rectangular shape (Fig. 9), with less prominent ribs and wide furrows. Comparing the histo-anatomy of this branch with the one belonging to the other two branches mentioned before, only a few differences appear, as follows:

- the tector trichomes are very rare;
- the periphloemic mechanical fibers presents thick, but weak lignified walls (Fig. 10);
- the phloem and the xylem presents a secondary structure;
- the cambium is continuous on the whole stem circumference;
- the ring of secondary phloem is thicker, but the tracheogenesis is still in process (the elements which are near the cambium present thin and cellulosed walls).

The leaf

The petiole

The cross section through the petiole has a semicircular shape (Fig. 11), modified by two latero-adaxial wings which delimit a wide and quite deep furrow.

The epidermis presents izodiametric cells, with the external wall thicker than the others and covered by a thin cuticle. Short multicellular secretory trichomes (consisting in a basal cell, a pedicel and a bicellular gland) are present in the adaxial face and numerous multicellular tector trichomes; quite similar trichomes are present in the abaxial face and in the latero-adaxial wing.

In the fundamental parenchyma, of meatus type, the vascular tissues form 7-8 vascular bundles; the middle bundle (Fig. 12) is the biggest of all and has an arcuate shape in cross section.

The phloem consists in sieved tubes and companion cells and forms small isles separated by very big parenchymatic cells. The xylem consists in vessels disposed in radiary rows, separated by celullosed parenchymatic cells.

The foliar blade

In front side view, the cells shows an irregular shape, with strongly waved lateral walls. Here and there a lot of stomata (Figs. 13 and 14) of diacytic type are present, together with trichomes:

- short multicellular tector trichomes;
- massive, multicellular secretory trichomes and short secretory trichomes, similar to those occurring in the epidermis of the petiole, with bi- or tetracellular gland.

In cross section, the midvein (Fig. 15) is very prominent at the abaxial face and presents a similar structure to that occurring in the petiole:

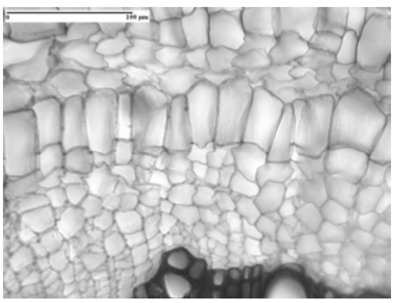
- epidermis which consists in small cells, with the external wall thicker than he others and covered by a ridged cuticle;
- numerous glandular (Fig. 16) and multicellular tector trichomes are present at the adaxial face;
- fundamental parenchyma, of meatus type;
- a big vascular bundle with arcuate shape (Fig. 17).

Between the lateral veins, numerous epidermic cells are tangential elongated, being covered by a thinner cuticle; stomata are present in both epidermis, so, the foliar blade is amfistomatic. The mesophyll (Fig. 18) consists in palisade tissue to the upper epidermis and lacunary tissue to the lower epidermis, so, the foliar blade has a bifacial-heterofacial structure. The palisade tissue is unilayered, with large and less high cells while the lacunary tissue is three-layered, with elongated cells.

The secretory trichomes are located in small cavities of the adaxial face.

References

1. BRAEMER L., SUIS A., 1900- Atlas: *Photomicrographie des plantes médicinales*. Ed. Vigot Freres, Paris
2. GUŞULEAC m., 1961- *Ocymum* L. În *Flora R. P. R.*, Ed. Acad., Rom., Bucureşti, **8**: 390-393
3. METCALFE, C. R., CHALK, L., 1972- *Anatomy of the Dicotyledons*. **2**. Clarendon Press, Oxford: 1041-1053
4. NAPP-ZINN, Kl., 1984- Anatomie des Blattes. II. Angiospermen. In *Handbuch der Pflanzenanatomie*, **8**, 2A 1-2, Gebrüder Borntraeger, Berlin, Stuttgart
5. RUGINĂ R., TOMA C., 1995- Histo-anatomical researches of some medicinal plants. V. *Labiatae*. *An. Şt. Univ. "Al. I. Cuza" Iaşi*, s. a II-a (Biol. veget.), **41**: 17-22
6. SÁRKÁNY S., SZALAI I., 1964- *Növénytani Prakticum*. I. Növényszervettani Gyakorlatok. Tankönyvkiadó, Budapest
7. TOMA C., RUGINĂ R., 1998. *Anatomia plantelor medicinale.* Atlas. Ed. Acad. Rom., Bucureşti
8. TOMA-GOSTIN I., TOMA C., IVĂNESCU L., 2002- Histo-anatomical aspects of *Ocimum basilicum* L., an important medicinal plant. *2-nd Conference on Medicinal and Aromatic Plants of Southeast European Countries*. Chalkidiki-Greece (Book of abstracts): 140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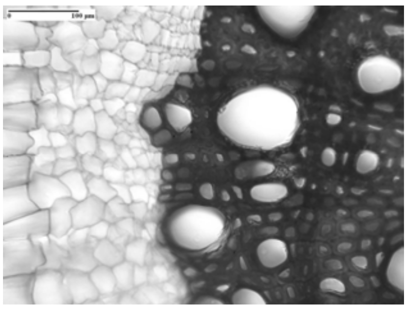
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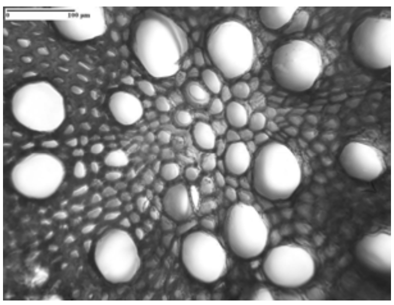
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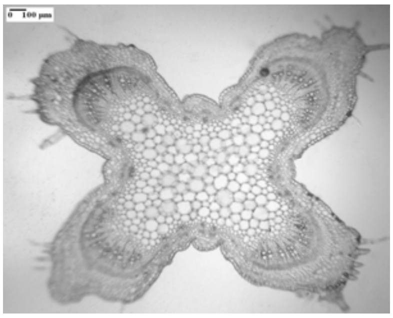

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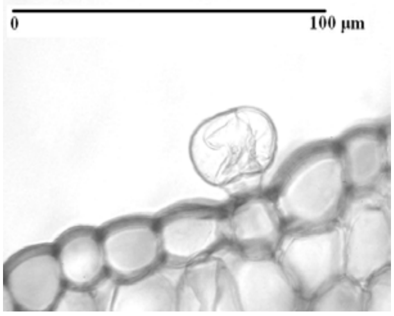

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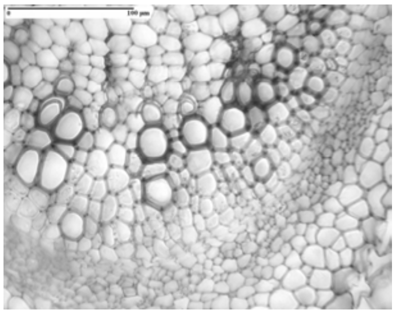


Fig. 6

Cross section through the root: detail of the suber and the phloem (Fig. 1); detail of the phloem (Fig. 2); detail of the massive body of the xylem (Fig. 3). Cross section through the tenuous branch of the stem: general view (Fig. 4); secretory trichome (Fig. 5); big vascular bundle (Fig. 6).

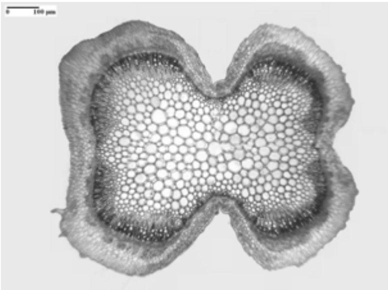


Fig. 7

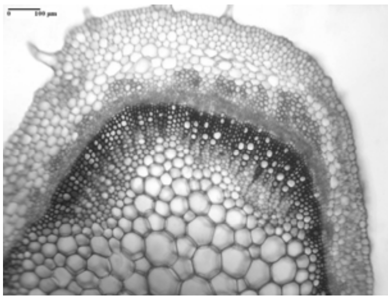


Fig. 8

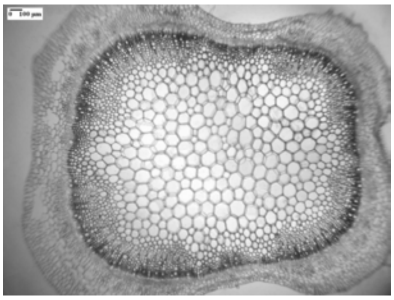
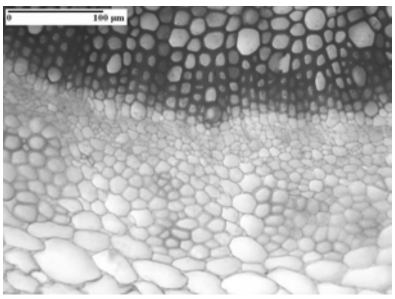


Fig. 9



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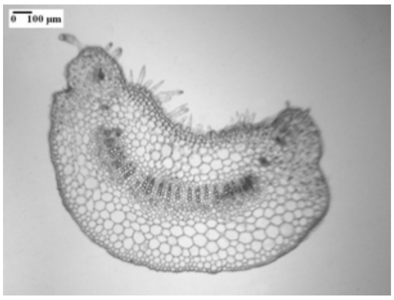

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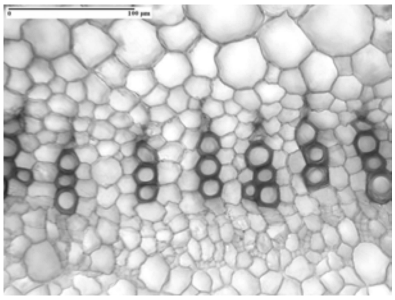

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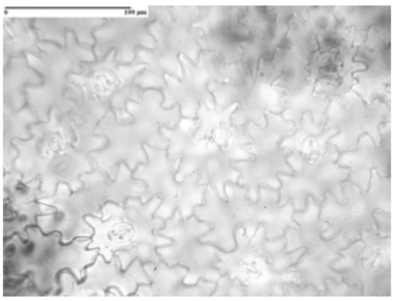

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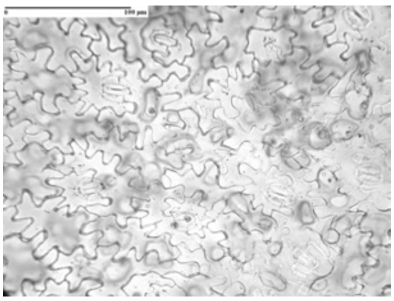
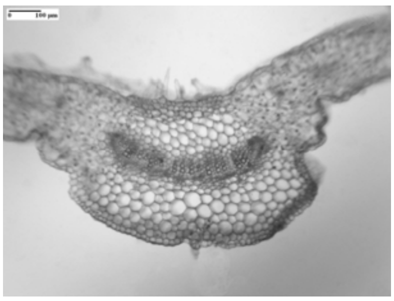


Fig. 14



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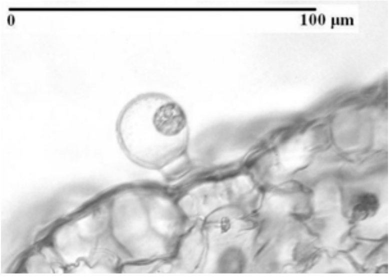

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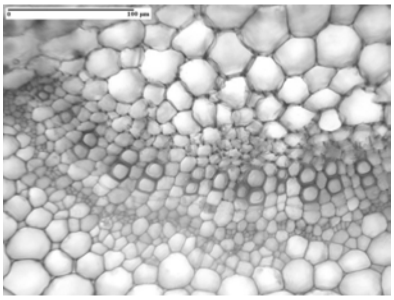

Fig. 17

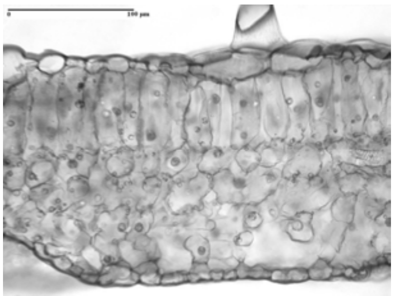

Fig. 18

Cross section through the thick branch of the stem: general view (Fig. 7); tissues belonging to one rib (Fig. 8). Cross section through the very thick branch of the stem: general view (Fig. 9); big vascular bundle (Fig. 10). Cross section through the petiole: general view (Fig. 11); vascular bundle (Fig. 12). Front side epidermis view: the upper epidermis (Fig. 13) and the lower epidermis (Fig. 14). Cross section through the foliar blade: general view (Fig. 15); secretory trichome (Fig. 16); vascular bundle (Fig. 17); mesophyll consisting in palisade tissue and lacunary tissue (Fig. 18).

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PART II - ANIMAL BIOLOGY

ASPECTS REGARDING THE VALUE OF THE MOLLUSCA FROM THE LAKES FURTUNA AND BACLANESTI (DANUBE DELTA BIOSPHERE RESERV)

ADINA-MARIA LEFTERACHE*

ABSTRACT

LEFTERACHE A.M., 2006 – Apects regarding the value of the mollusca from the lakes Furtuna and Baclanesti (Danube Delta Biosphere Reserv). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 222-229.

As consequence of the pollution made by the different riparian states, of the climatic modifications of the former years, the fresh water malacological fauna has suffered modifications consisting in the diminution of the populations or even in the extinction of some gastropods and bivalves species during the last decades

On the basis of the data offered by my own research in two aquatic ecosystems in the delta (the lakes Furtuna and Băclăneşti), the present work describes the species of gastropods and bivalves identified in these places and those value in the economical frame of the nature.

The observations for the lakes Furtuna and Baclăneşti were made in the period May-September 2001-2004.

Through the structure of the bivalves and gastropods fauna, the studied zones reflects the substratum particularities (through a differentiation in two types of habitats completely different: one characteristic for the flowing waters, natural or almost natural, *Esperiana esperi*(Feruss) and the second type for the waters rich in aquatic macrophytes, stagnant waters or slow flowing waters - *Viviparus contectus*(Millet,1813), *Bithynia leacki*(Schepp.,1823), *Bithynia tentaculata*(L.,1758), *Radix ovata*(Drap.,1805), *Physa fontinalis*(L.,1758), *Lymnaea stagnalis*(L.,1758), *Planobarius corneus*(L.,1758)) and the particularities of the different regime of matter and energy circulation.

Key words: prosobranchia, archaeogastropoda, mesogastropoda, pulmonata, basommatophora

Introduction

The determination of the malacologic fauna composition in an aquatic basin is very important, the composition offering information about the respective ecosystem. Both the bentonic and the planktonic organisms must be examined. The composition of these biocenoses may vary in the same water from a year to another.

So far, the research made in the Danube Delta have underlined the fact that the mollusca have the biggest systematic importance; here the biggest number of species is represented and compose different ecological categories in accordance with the environment which they populate.

Regarding the lakes of the delta, the following authors elaborated lists of species with indications of the respective biotopes and biocenoses and quantitative appreciations at the group level, which aren't always explained by the action of the ecological facts: Enăceanu, 1953; Munteanu, 1959; Popescu, Ziemiankowski and Radu, 1956; Popescu and Munteanu, 1962. In 1965, Grossu and Palladian published more observations about the mollusca of the lakes Roşu, Gorgova, Pardina, Uzlina and others. In 1973, 1983, 1986, Kiss, Rèkási, Richnovsky specified the most frequent species of mollusks which are part of the ornitho-fauna food. In 1973, Doung Lan realized an ecological study of the populations of the *Viviparus acerosus* (Bourg), *Planobis corneus* (L.1758), *Lymnaea stagnalis* (L.1758) in 3 biotopes: Hagioaia, Matiţa and Trei Iezere. In 1984 Vădineanu and Sidi El Moctar studied the structure and the role of the population of the species *Dreissena polymorpha* (Pallas,1771) in the lakes Roşu and Matiţa.

More recent studies (Kiss, Barkany, 1995) give lists of species identified in 22 points which contain almost the entire delta's territory: the lakes Sinoe, Razelm, Golgoviţa, Trei Iezere, Roşu, Meşter and Merhei, the areas of the localities Maliuc, Caraorman,

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Crişan and the Chilia arm. In 1998, the same authors published a study of the strictly protected areas Răducu, Nebunu, Vătafu-Lunguleţ; Sárkány-Kiss and Ioan Sârbu published a study about the mollusca's associations in the lakes Roşca, Rotundu, Belciug, Sărături Murighiol and Merhei.

On the basis of the data offered by my own research in two aquatic ecosystems in the delta (the lakes Furtuna and Băclăneşti), the present work describes the species of gastropods and bivalves identified in these places and those value in the economical frame of the nature.

Material and method

The observations for the lakes Furtuna and Baclăneşti were made in the period May-September 2001-2004.

The biologic material was collected using a limnological net (Fig.1)

Fig. 1

(for the gastropods situated on the aquatic vegetation), but also manual for the bentonic species, which are mostly the bivalves. For the studied species, the drowning was made from 6 stations as following: for the Lake Furtuna (1.South-East; 2.East; 3. Centre; 4.West; 5.North; 6.North-East) and for the lake Baclanesti (1. South-East; 2.East; 3.North; 4.North-West; 5.Centre; 6. South)

In the period of the months when the low level of the water braked the drowning from certain zones of the lakes, the number of the stations has been reduced at 4 or even 3 (Fig.2)

Fig. 2 - Cranjala Channel - the low level of the water

The number of drawings per station was 10.

The drawn species were introduced in plastic or glass containers filled with preservative liquid (alcohol).

Results and discussions

As consequence of the pollution made by the different riparian states, of the climatic modifications of the former years, the fresh water malacological fauna has suffered modifications consisting in the diminution of the populations or even in the extinction of some gastropods and bivalves species during the last decades.

This fact could be observed also in the two ecosystems Furtuna and Baclanesti, where a reduced number of species was found. During the studied period a number of 14 species of gastropods and 3 species of bivalves have been identified. (See Tabels).

No. crt.	Classe/Subclasses Order/Family	Species	Area and year
1.	Gastropoda/Prosobranchia / Archaeogastropoda/ Neritidae	*Theodoxus danubialis* (C.Pfeiff,1828)	Furtuna 2002 Baclanesti 2003
2.	Gastropoda/Prosobranchia / Mesogastropoda/ Viviparidae	*Viviparus viviparous* (L.,1758)	Furtuna 2001-2004 Baclanesti 2001,2002
3.	``	*Viviuparus* sp.(juv.)	Furtuna 2001,2002
4.	``	*Viviparous acerosus* (Bourguignat, 1870)	Furtuna 2001-2003
5.	Gastropoda/Prosobranchia /Mesogastropoda/ Bithynidae	*Bithynia tentaculata* (L.,1758)	Furtuna 2002-2003
6.	``	*Bithynia leacki*(Schepp.,1823)	Furtuna 2002 Baclanesti 2003
7.	Gastropoda/Prosobranchia / Mesogastropoda /Thiaridae	*Esperiana acicularis* (Feruss)	Furtuna 2002-2003
8.	``	*Esperiana esperi* (Feruss)	Furtuna 2002
9.	Gastropoda/Pulmonata /Basommatophora/ Physidae	*Physa acuta* (Drap.,1805)	Furtuna 2002
10.	Gastropoda/Pulmonata /Basommatophora/ Lymanaeidae	*Lymnaea stagnalis* (L.,1758)	Furtuna 2001-2004 Baclanesti 2001-2004
11.	``	*Stagnicola palustris* (O.F.Mull,1774)	Furtuna 2002-2003 Baclanesti 2002
12.	``	*Radix ovata* (Drap.,1805)	Furtuna 2001-2004 Baclanesti 2003
13.	``	*Radix auricularia* (L.,1758)	Furtuna 2002
14.	Gastropoda/Pulmonata /Basommatophora/ Planorbidae	*Planorbis planorbis* (L.,1758)	Furtuna 2001-2002
15.	``	*Planorbarius corneus* (L.,1758)	Furtuna 2001-2004 Baclanesti 2001-2004

No.	Classes/order/family	Species	Area and year
1.	Bivalvia/ Unionida/ Unionidae	*Unio pictorum* (L.,1758)	Furtuna, 2001-2003 Baclanesti 2001-2003
2.	``	*Anodonta cygnaea* (L.,1758)	Furtuna, 2001-2003 Baclanesti 2001-2004
3.	Bivalvia/Veneroida/ Dreissenidae	*Dreissena polymorpha* (Pallas,1771)	Furtuna, 2001

The number of the species and their density varied a lot both from a year to another and, in the course of the same year, from a month to another. The high densities remained until the end of July. After this month mass mortality were been registered, both at gastropods and especially at bivalves.

The situation was due to the decrease of the water level because of the prolonged summer dryness (in 2001 the lake Furtuna water level was 1.70 cm and the lake Baclanesti 1.65 cm; in 2001 the lake Furtuna water level was 1.60 cm and lake Baclanesti 1.40 cm; in 2003 the lake Furtuna water level was 60 cm and lake Baclanesti 55 cm). This was the longest period of dryness which last until the beginning of the autumn (Fig.3). The consequences for the water mass were the following: the oxygen quantity decreased very much (at 0,29 mg/l, the enormous quantity of macrophyte vegetation (Fig.4) in a state of incipient degradation, the bottom covered with black mud having an organic nature which determined an acid reaction, the slowing down of the lakes' fluvial water supply and its weak circulation in the lakes' precincts. The enormous quantity of vegetation (see the photo Abundant vegetation), represented by the species: *Elodea canadensis, Myriophillum spicatum, Potamogeton perfoliatus, Potamogeton pectinans*, indicated a strong eutrophic character of the water.

Fig. 3

Fig.4 – Degraded macrophyte vegetation with dead molluscs

The presence of the gastropods species *Planorbarius corneus* (L.,1758), *Lymnaea stagnalis* (L.,1758) and of the macrophyte *Potamogeton perfoliatus* (species indicators of the mesotrophic-eutrophic waters) indicates the fact that the ecosystem hadn't suffered an accented perturbation yet. The situation was repeated again in the summer of 2004 but it didn't have the same effects like in 2003, despite the fact that the number of molluscs had had an accented decrease.

As it could be observed, any modification of an ecosystem frame put its print on the populations living there.

When we are talking about the importance of the molluscs, we refer (for the Romanian territory) only at their value for the nature's economy because, after 1990, their use in certain industrial branches is practically inexistent (nacre factory, buttons factory, zootechnics etc.).

In an aquatic ecosystem, when we refer at their importance, we refer at their energetic, geomorphologic, ecological and filtrating value.

Gastropods

Energetic value

The study of the dynamic of the number and biomass of gastropods populations and associations from the aquatic ecosystems indicated that these are enough important in the ecosystems' matter circuit. Certain species are part of the main trophic chains:

Viviparus acerosus (Bourguignat, 1870) – Fig.5 – Danubian and Balkans species, which lives in rivers and lakes, preferring those which rich vegetation. In the Danube, it is lithophile, periphitic and briophile (DUDICH, 1967). In the swamps with vegetation from the easily flooded zone, it is frequent in the sublittoral zone, on mud substratum (POPESCU-GORJ and COSTEA, 1961).

Fig. 5

Esperiana acicularis(Feruss) – Pontic and Danubian species, found in the springs, brooks, rivers and in the lakes of the flood plains. In the Danube it is lithophile and placophile (DUDICH, 1967); in the northern delta's creeks, it populates the sandy-clayey and less muddy bottoms from the littoral zone and when the submerged and emerged macrophytes are in full vegetation, it climbs on them (MARKOWSKI, 1959).

Esperiana esperi (Feruss) - – Pontic and Danubian species, lives in the same types of water and in the same biotopes like the precedent species with which it lives together.

These species are consumed by the fish with mixed nutrition (NEGREA,1975). So, it can be deduced that they participate in the short trophic chains (algae from microphyte bentos – pelophyle gastropods – fish). These short chains which begin with living vegetable organisms consumed by herbivorous species, have a positive role because, in the absence of supplementary links between the producers and the final consumers, there is no inutile looses of energy to decrease the ecosystem efficiency. Certain species participate also in the chains which begin with the dead organic material (detritivorous), being part of more chains and being in this way common links of more trophic cycles.

Other species of gastropods compose the ornitho-fauna food:

Esperiana esperi (Feruss)*; Esperiana acicularis* (Feruss); *Bithynia tentaculata* (L.,1758) – Palaearctic species which populates the creeks, rivers, lakes and saltish waters. In the Danube, it is lithophile, placophile, macrophytophile (DUDICH, 1967). In the Danube flood plain, it prefers the swamps rich in vegetation (POPESCU-GORJ şi COSTEA, 1961). The species of birds which consumes these gastropods are: *Anas platyrhyncos*, *Pulica atra*, *Anser anser* and *Phasianus colchicus*.

Geomorphologic role

In time, the huge quantities of shells (both of the gastropods and of bivalves) which remain after their death are crumbled and taken away by the waves and the streams in more quiet places where they represent an important material for the construction of the banks, tops of the banks ridge and rivers' bottom.

On the tops of the rivers ridges, the reed installs, changing the swamps configuration, the direction and the streams force, the processes of deposit formation and erosion. In other words, the morphology and the structure of the bottom and of the banks is changing, influencing the biologic processes from the water (BOTNARIUC, NEGREA, TUDORANCEA, 1964).

Ecologic role

In an aquatic ecosystem, beside other categories of hydrobionts, the gastropods are good indicators of the quality of the aquatic basin's water. This is an ecological method for the biological analysis of the aquatic environment. The method is named *the saprobic system* and it was revised by Liebmann. The system is orientated more to the species and less to the biocenoses; it refers exclusively to the waters impurified with organic substances and doesn't regard the mineral pollution.

Some species of gastropods are also indicators for the α-mesosaprobic waters (waters characterised by processes of reduction and beginning of the oxidations and also by the small quantity of organic matter). As consequence of the development in mass of the phytoplankton, the phenomenon of water "flourishing" can take place; in the day course a supra saturation of the water with oxygen, and in the night a deficit of oxygen. The average percent of oxygen is 50%. These species are: *Lymnaea stagnalis*(L.,1758) (Fig.6), *Planorbarius corneus* (L.,1758) (Fig.7), *Bithynia tentaculata* (L.,1758) (Fig.8).

Fig. 6

Fig. 7

Fig.8

There are also negative aspects regarding these species biology. They are the intermediary hosts of different forms of parasites which cause diseases of the fish populations and even of the human. *Bithynia tentaculata* (L.,1758) and *Bithynia leachi* (Schepp., 1823) are the intermediary hosts for the trematodes. When adult, *Opisthorchis felineus* is the parasite of the human, dog, cat and pig, located in the billiar canals and rarely in the intestines or pancreatic canals. *Radix* sp. and *Lymnaea stagnalis* are the intermediary hosts for the parasites which causes the sanguinicolosis at the carp (*Ciprinius carpio* L., 1758), the crucian (*Carassius auratus gibelio* Bloch,1783 and (*Carassius carassius* L.,1758) etc.)

Lymnaea stagnalis(L.,1758) is also the first intermediary host for the parasite which causes worm cataract at the fresh water fishes.

Planorbis sp. is used by the trematode which causes the "black spots" disease at the fishes.

Bivalve

Energetic role

Starting with the trophic model imagined by Lindeman (1941) and further developed by other ecologists (Odum (1959), Mac Fadyen (1963)), the energetic role of the bivalves' populations from the aquatic ecosystems can be appreciated.

Unio pictorum (L.,1758) (Fig. 9) – usually lives in slow downing waters or even in rivers, buried in sand or mud, but it can be also met in the big swamps of the easily flooded plain of the Danube or along the rivers, which water are mostly stagnant and more or less rich in aquatic vegetation. It cannot be met at altitudes higher than 500-600 m (GROSSU, 1956).

Fig. 9

In the studied ecosystems (TUDORANCEA, 1967) it has been ascertained that the juvenile individuals have an activity of mineralization of the water's organic substances which is more intense than that of adults individuals.

In the respiration processes, the intensity and the capacity of mineralization are in inverse proportion with the body's growth.

Regarding the trophic aspect, the populations of *Unio* sp. and *Anodonta* sp. have a reduced importance because they put a small quantity of energy from the total quantity of assimilated energy at the disposition of other trophic levels. If we add the fact that the individuals have a long life in which they store and immobilise matter and energy in their body, matter and energy which they put again into the ecosystem's energetic circuit after a long period of time, that means they trophic-dinamic role in the ecosystem's frame appears to be so much to less.

Dreissena polymorpha(Pallas,1771) – lives in lakes, slow downing channels, rivers, and periodically flooded swamps, staying fixed on the woods, walls, rocks, on the trunks of willows, reed etc. It often gets into the water tubes or can be found fixed on the moving floating objects like: boats, ships, and sometimes fixed on the valves of the genus *Unio*, *Anodonta, Monodacna* and sometimes on the gastropod *Viviparus*. They often catch ones to the others forming clusters, sometimes enough big, especially in the lakes without hard substratum – the frequent case met, and sometimes even on the reed stems (GROSSU, 1956)(Fig.10).

Fig.10

Dreissena sp. is a much appreciated species in the aquatic basins from our country. This is characterized by a big fecundity and the possibility of developing in very varied conditions of living and which has, at the same time, an appreciable nutritive value, together with the increase of the biological productivity of the aquatic basins.

Dreissena polymorpha(Pallas,1771) is an important trophic object in the food of the benthophagous fish species. Although it presents a caloric value bigger than that of *Gammarus* sp. and *Chironomus* sp., this can be considered the first, if it is taken in consideration the unitary weight of the animal and the total caloric value (SCHAPERCLAUS, 1962).

The total calculated caloric value for *Dreissena* was 5,5 - 6,6 kcal/g. At the same time, the vitamine A (0,090 - 1,383 mg %), the vitamine B1 (0,090 - 1,814 mg %) and the vitamine B2 (0,831 mg %) were been found in some samples (ONEA, TOMA, STĂNCIOIU, POPP, 1969).

There are some negative aspects of this species' biology. This is the intermediary host for some parasite worms of the fishes. It is intermediary host for the trematode *Catapteroides macrocotyle*, which eggs get together with the water into the body of this bivalve. The cercariae of the parasite get into the fish and fix themselves in urethras and kidneys (NIKOLSKII, 1960).

Due to its nutritive value, its introduction in different aquatic basins has been proposed. In this way, the nutritive value of the respective biocenoses can be increased and it can be used as object of displacement into the small new aquatic basins created on the grounds with low productivity, where it will contribute at the enrichment of the natural food of the fishes (ONEA, TOMA, STĂNCIOIU, POPP, 1969). It has also an important role in the mineralization of the water's organic substance. There are species of bivalves which constitute the food almost exclusive of the sturgeons.

Filtrating role

The bio filtrating value of the bivalves is well known. A big quantity of water passes through their siphons: at certain species, few litres per hour, retaining all the organic suspensions which constitute their basic food. The water remains clear and organic disturbances which would consume much oxygen and would make the fishes' life impossible (because of the depreciation of the water quality), decreasing their biological productivity don't take place (GROSSU, 1956).

Their role is manifested in the possibility of the oxidation of the organic materials taken from the water and in their capacity of purifying the water from the suspensions.

Regarding the first aspect, this was proven by the high values of the breathing intensity of the individuals from the species *Anodonta*, *Unio* (TUDORANCEA, 1967). This aspect is more intense at the juvenile individuals.

The filtration speed, which is second aspect, is in an inverse proportion with the dimension and the body's weight. For example, at the same time with the growth of the body's dimensions at *Anodonta piscinalis* (from 68 mm to 105 mm), a decrease of the filtration speed is noted, from 6765,5 ml/ex/h to 3812,5ml /ex/h; at *Unio pictorum*, for an increase from 42 mm to 97 mm, a decrease of filtration from 3887,5 ml/ex/h to 687,5 ml/ex/h; at *Unio tumidus* for a length increase from 57 mm to 66 mm, a decrease of the filtrating speed from 3662,5 ml/ex/h to 3587 ml/ex/h (TUDORANCEA, 1967).

Another fact is that some bivalves are sensitive at the concentrations of the suspensions in the water. Making experiences in the same conditions of temperature and water saturation in oxygen but in different concentrations of the suspensions in the water (12 mg/l and 2mg/l), it was noted that the bivalves filter a bigger quantity of water per time unit when the suspensions have low levels of concentration. The result seems natural in such conditions because the larvae must filter a bigger quantity of water to ensure their feeding necessities.

Following the literature data, *Unionidae* are the most important purifying agents of the fresh waters aquatic ecosystems.

The most popular species (for the Danube Delta territory): *Unio pictorum* (L.,1758) and *Anodonta cygnaea* (L.,1758) (Fig.11) belong to this family.

Fig. 11

When the quantity of organic substances and particles being in suspension in the water's mass, is bigger than the bivalves' filtration capacity, the phenomenon of siphon's clogging appears. In this case, mortality in mass appears. Such situation was recorded in the lakes Furtuna and Baclanesti and on the channels, in July – August 2004 and 2004.

Ecologic role

Beside gastropods, these are important as bio indicator species in what concerns the biologic quality of the aquatic ecosystems' waters.

Between the indicator species, after the saprobic system, we mention: *Unio pictorum* (L.,1758) - for the waters oligo and beta mesoprobic;

There are also negative aspects of the bivalves' biology *Unio* sp. and *Anodonta* sp. The glochidia (Fig. 12 and Fig. 13) of these species shelter sporocysts, rediae, cercariae of Bucephalus polymorphus. This trematode causes intestinal illnesses at species of fish of prey and cutaneous diseases at clupeidae.

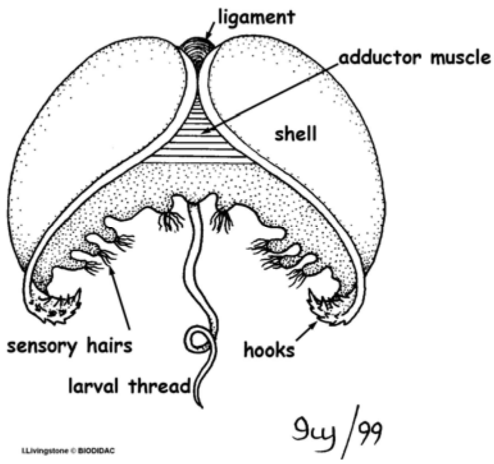

Fig.12 - Larva glochidium - *Anodonta cygnaea* (L.,1758)
h- shell; z-adductor muscle; t, k- sensory hairs; b- larvar thread

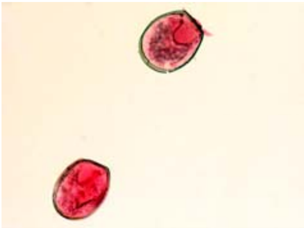

Fig.13

Conclusions

Through the structure of the bivalves and gastropods fauna, the studied zones reflects the substratum particularities (through a differentiation in two types of habitats completely different: one characteristic for the flowing waters, natural or almost natural, *Esperiana esperi* (Feruss) and the second type for the waters rich in aquatic macrophytes, stagnant waters or slow flowing waters - *Viviparus contectus* (Millet,1813), *Bithynia leack i*(Schepp., 1823), *Bithynia tentaculata* (L.,1758), *Radix ovata* (Drap.,1805), *Physa fontinalis* (L.,1758), *Lymnaea stagnalis* (L.,1758), *Planobarius corneus* L.,1758) and the particularities of the different regime of matter and energy circulation.

The ecological preferences of the identified species reflect their link with their environment, confirming again the value of molluscs as bio indicator species.

As it could be observed, any modification of the environment can determine changes more or less profound of the existent species. Certain ecosystems, through the big number of the present species, presents a good ecological estate, others present an accented degree of eutrophisation (the lakes Furtuna, Baclanesti) due to the weak circulation of the water and to its low level in the period of prolonged dryness. But the problem isn't very grave. In the future, through reconstruction measures and strict protection of these zones, these lakes can become genetical reserves also for the mollusca fauna of the neighbouring zones which are not strictly protected.

Rezumat

Pentru Delta Dunării cercetările efectuate pănă în prezent, au evidențiat faptul că moluştele au cea mai mare importanță sistematică, aici fiind reprezenttate prin cel mai mare număr de specii, alcătuind în acelas timp categorii ecologice diferite, după mediul pe care-l populează.

In baza datelor oferite de propriile cercetări în două ecosisteme acvatice din deltă (Lacurile Furtuna şi Băclăneşti) următoarea lucrare descrie, speciile de gasteropode şi bivalve identificate aici si valoarea acestora in cadrul economiei naturii.

Pentru lacurile Furtuna şi Baclăneşti observațiile s-au derulat în perioada mai-septembrie a anilor 2001-2004.

Fauna malacologica dulcicola a suferit modificari in ultimile decenii ca urmare a amenajarilor si lucrarilor hidrotehnice,poluarea realizata de diferitele state riverane, modificarile climatice din ultimii ani, fapte ce se reflecta in diminuarea populatiilor sau chiar disparitia unor specii de gasteropode si bivalve.

Acest lucru s-a putut observa si in cele doua ecosisteme Furtuna si Baclanesti , unde a fost intalnit un numar redus de specii. In perioada studiata, au fost identificate un numar de 14 specii de gasteropode si 3 specii bivalve.

Gasteropodele si bivalvele identificate, reflecta pe de o parte particularitățile substratului (printr-o diferențiere în două tipuri de habitate complet diferite: unul characteristic pentru ape curgătoare, naturale sau aproape naturale- *Esperiana esper i*(Feruss) şi al doilea tip pentru ape bogate în macrofite acvatice,ape stătătoare sau lin curgătoare- *Viviparus contectus* (Millet,1813), *Bithynia leacki* (Schepp.,1823), *Bithynia tentaculata* (L.,1758), *Radix ovata* (Drap.,1805), *Physa fontinalis* (L.,1758), *Lymnaea stagnalis* (L.,1758), *Planobarius corneus* (L.,1758) iar pe de alta, regimului diferit de circulație a materiei şi energie.

Preferințele ecologice, evidentiaza foarte bine legătura acestora cu mediul lor de viață, confirmând încă odată si valoarea acestor hidrobionti ca specii bioindicatoare.

References

1. ANTONESCU C.S., 1967 - *Biologia apelor*. Edit. Didactică şi Pedagogică, Bucureşti, 270-285.
2. ANTONESCU C.S., RUDESCU L.,1956 - *Caracterizare hidrobiologică a apelor din Delta Dunării*. Hidrobiologia I, Edit. Academiei R.P.R., Bucureşti, 291-302.
3. BANU A.C., RUDESCU L. 1976 - *Limnologia sectorului românesc al Dunării-studiu monografic*. Edit. Acdemiei R.S.R, Bucurşti, 427-438.
4. BOTNARIUC N., 1982 - *Ecologie*. Edit. Didactică şi Pedagogică, Bucurşti, 163-170.
5. DOUNG LAN, 1974 - Rezumatul tezei de doctorat.
6. GROSSU AL.V., 1955-56 - *Fauna RPR, Molusca*, vol.III. Bucureşti, Ed. Academiei RPR, fasc.1: Gastropoda pulmonata; fascicula 2: Gastropoda prosobranchia şi opistobranhia; fascicula 3: Bivalvia.
7. IGNAT GHE., VADINEANU A., CRISTOFOR S.,1993 - *Structura şi dinamica faunei bentonice din Delta Dunării în anul 1993*. Analele Ştiinţifice ale Institutului Delta Dunării,Vol III, Tulcea, 87-94.
8. KISS B., RICHNOVSKY,1983 - *Moluştele în hrana ornitofaunei din Delta Dunării.*

9. MUNTEANU G., BOGATU D., 2003 - *Tratat de ihtiopatologie*. Editura Excelsior Art, Timişoara, 402-424;474-475;539-541.
10. NEGREA ST., NEGREA AL., 1975 - *Ecologia populaţiilor de cladoceri şi gasteropode din zona inundabilă a Dunării*. Ed. Academiei RSR, Bucureşti, 203-219
11. ONEA E., TOMA G., STANCIOIU S., POP V., 1969 - *Consideraţii asupra rolului speciei Dreissena polymorpha pallas în mărirea productivităţii biologice a bazinelor acvatice*. Buletinul Institutului de Cercetări şi Proiectări Piscicole, nr. 2., 45-57.
12. SÁRKÁNY-KISS A., 1995 - *Contribuţii la cunoaşterea faunei de moluşte acvatice din Delta Dunării*. Analele ştiinţifice al I.N.C.D.D., vol. IV /1.
13. SÁRKÁNY-KYSS A., 1997, *Studiu malacologic al ariilor strict protejate: Nebunu, Răducu, Vătafu-Lunguleț din R.B.D.D*. Analele ştiinţifice ale I.C.N.D.D., vol. VI / 1.
14. VASILESCU G., 1986 – *Hidrobiologie*. Univ.Galaţi-Facultatea de Tehnologia şi Chimia produselor Alimentare şi Tehnică piscicolă, Galaţi, 143-152.
15. VADINEANU A., SIDI EL MOCTAR AHMED TALEB, 1983 - *The structure and role of the Dreissena polymorpha Pall., population in same aquatic ecosystems of the Danube Delta*, 63-81.
16. TUDOR M., 2002 - *Reintegrarea sistemelor antropizate neutilizate eficient din Rezervaţia Biosferei Delta Dunării în sistemele naturale.* Sinteza lucrărilor de cercetare - Orizont 2000 - 2002, Ministerul Apelor şi Protecţiei Mediului, I.N.C.D.D., Tulcea, 9-2.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA” BACĂU

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QUALITATIVE AND QUANTITATIVE STUDIES UPON THE EDAPHIC MICROARTHROPODS FAUNA IN SOME GRASSLAND ECOSYSTEMS FROM MOLDAVIAN PLAIN (ROMANIA)

ADINA CĂLUGĂR *

ABSTRACT

CĂLUGĂR A., 2006 – Qualitative and quantitative studies upon the edaphic microarthropods fauna in some grassland ecosystems from Moldavian plain (Romania). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 230-231.

In this paper it were analyzed 4 orders of mites (*Gamasida, Oribatida, Actinedida, Acaridida*), one order belonging to *Insecta* Class (*Collembola*) and, on the whole, some other insects and microarthropods groups (myriapods, pseuoscorpiones etc).

Key words: ecosystems, anthropic pressure, edaphic microarthropods

Introduction

Part of the Moldavian Plateau, the Moldavian Plain is placed in the North-East of Romania between Prut River (at East) and Bour-Dealul Mare Peak (at West).

Nowadays, the forests and the natural grasslands of the territory are being replaced, most of them, by agro-ecosystems. The edaphic microarthropods, especially some groups, with a great selectivity versus the bio-edaphic conditions, reflect the modifications that the human activity has brought about in their life conditions; by studying these groups we can also get useful information about the soil quality and the peculiarities of an ecological station; at the same time, these groups could show us the functional state of the ecosystems, on the whole.

Material and methods

It were selected 11 ecological stations: 6 pastures (Valea lui David - protected area, Vulturi, Horleşti, Sărata – Româneşti, Deleni, Uricani) and 5 hay fields (Ripiceni, Săveni, Deleni, Scobâlțeni, Valea lui David).

From each of these stations 5 soil samples (with a surface of $100cm^2$) has been taken over; extraction of the edaphic mesofauna was performed by the Tullgren – Berlese method, in Balogh variant, and then it were sorted out on systematic groups. The faunistic material was analyzed being recorded sample by sample the abundance for each of the present groups.

On the bases of the primary data it was calculated the average abundance in individuals/$100cm^2$ /systematic groups (Ā);

Results and discussions

In the natural ecosystems, the maximum values of the edaphic microarthropods densities are over 200 individuals/100 cm^2 (in the case of the wet pasture from Uricani and from the protected area Valea lui David), and the minimum one, only 62,8 individuals/$100cm^2$ (for the hay field deteriorated by depasturage - Deleni) (Tab. 1).

In the anthropic ecosystems the densities of the edaphic microathropods are between 135.4 and 620 individuals/100 cm^2, the most populated one being Săveni; it follows Ripiceni pasture with densities which are approximately 4 and respectively 2 times bigger than in the rest of the stations, where the values are comparable. So, the densities from pastures and hay fields have, generally, the same values with two exceptions, that of the Ripiceni pasture and that of Deleni hay field, where the values are the biggest and, respectively, the lowest ones, from the series of the stations which were taken into study (Table 1).

A ratio made on taxonomic groups relieved with little exceptions that the mites prevails both in pastures and in hay fields. The collembolans are

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much numerous only in the pasture of Săveni, where they hold much then a half from the total of the edaphic microarthropods. Among the mites it has been observed that the oribatids has dominated in the case of pastures with 56-63 %, in the case of hay fields they dominated, being 50-76% from the total of mites. The exceptions are represented by the salty pasture from Ripiceni and also by the Uricani hay field, where the actinedid mites are the most abundant (about 50% from the mites' total). The most slightly represented are the acaridid mites, especially in hay fields (1.6-9.6%), in the pastures these mites being at a draw with gamasid mites (20%).

The ratio between the main detritomicrophytophagous groups (oribatid mites/collembolans) is, as a general rule, in favour to the mites. Only in the peculiar conditions from the two pastures (Ripiceni and Săveni) and that from the Uricani hay field the collembolans are much numerous, their populations being probably stimulated by the highest humidity which characterize these stations.

Conclusions

The investigation on the edaphic mesofauna has shown that the quantitative and qualitative features depend in a great extent on the biopedoclimatic stational conditions. It was emphasized differences owned to the degree of the environment anthropization (like depasturage). Also, it has been observed differences due to the peculiar abiotic conditions (excess of humidity, for example).

Rezumat

Parte a Podişului Moldovei, Câmpia Moldovei, se găseşte N-E României şi are o suprafaţă de aproximativ 8.000 km^2. În prezent, pădurile şi pajiştile de pe acest teritoriu sunt înlocuite în cea mai mare parte prin agroecosisteme.

Microartropodele edafice şi, îndeosebi, unele grupe ce au o selectivitate deosebită în raport cu condiţiile bioedafice, reflectă modificările ce survin din diferite cauze, la nivelul mediului lor de viaţă; studierea lor aduce informaţii utile cu privire la calitatea solului, dar şi la starea funcţională a ecosistemului, în ansamblu.

În lucrarea de faţă sunt prezentate rezultatele referitoare la fauna de microartropode edafice din două tripuri de pajişti (fâneţe şi păşuni) din Cîmpia Moldovei.

References

1. CĂLUGĂR A., 2005 – *Influenţa aridizării asupra microartropodelor edafice din ecosisteme praticole din lunca Prutului*. Cel de-al X-lea Simpozion de Microbiologie şi Biotehnologie, 15-16 oct, ed. Corson, Iaşi, 471-474
2. DZIUBA S., 1966 – *Quantitative ratio between Mesostigmata, Trombidiformes and Sarcoptiformes in soil of cultivated fields*. Problems of Acarology, Acad. Sc. Pologne, 205 -206.
3. KRANTZ G. W., 1978 - *A manual of Acarology*. Second ed., Oregon State Univ., Book Stores Inc. Corvalis, 509 pp.
4. LEBRUN PH., 1971 – *Ecologie et biocenotique de quelques peuplements d'arthropodes edaphiques*. Inst. Roy. Sc. nat. de Belgique, Bruxelles, 165, 203 pp.
5. WALLWORK J.A., 1970 - *Ecology of soil animals*. Mc Graw-Hill Publishing Company Limited, Maidenhead-Berkshire (England): 283 pp.
6. WALLWORK J.A., 1976 - The *Distribution and Diversity of Soil Fauna*. Academic Press Inc. (London) Ltd.: 355 pp.

Tab. 1 - Average density of the edaphic microarthropods from the analyzed pastures

Systematic group	Stations										
	hay fields						pastures				
	1	2	3	4	5	6	7	8	9	10	11
Oribatida	157.2	93.6	34.4	90.6	17.2	39.8	20.6	151.2	56.6	47.6	63.0
Gamasida	12	14.8	16	18.6	7.6	13.2	38.2	23.6	18.2	14.4	18.2
Actinedida	38.4	22	10.6	10.8	9.4	70	37.6	36.6	2.8	-	2.8
Acaridida	-	-	0.2	0.2	-	1.2	91.0	40.8	16.0	21.8	16.0
Total Acari	207.6	130.4	61.2	120.2	34.2	124.2	**187.4**	**252.2**	**93.6**	**83.8**	**100.0**
Collembola	32.6	50.8	24	35.4	13.6	125.4	64.4	363.2	29.0	28.4	29.0
Other insects	1.4	4.6	5.4	4	13.6	4.6	30.6	2.6	11.2	21.8	11.2
Total Insecta	34	55.4	29.4	39.4	27.2	130	**95**	**365.8**	**40.2**	**50.2**	**40.2**
Other groups	1.2	3.4	10.2	8.6	1.4	2.8	6.0	2.0	1.6	3.6	1.6
TOTAL	*242.8*	*189.2*	*100.8*	*168.2*	*62.8*	*257*	***288.4***	***620.0***	***135.4***	***137.6***	***141.8***

Legend: 1, 11 - Valea lui David ; 2 - Vulturi; 3 - Horleşti ; 4 - Sărata; 5 - Deleni; 6 - Uricani; 7 - Ripiceni; 8 - Săveni; 9 - Deleni;10 – Scobâlţeni.**;** the values represent the average of the abundance in individuals/100 cm^2

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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ON THE GAMASID FAUNA (*ACARI: GAMASINA*) FROM THE GRASSLAND ECOSYSTEMS OF THE MOLDAVIAN PLAIN (ROMANIA)

ADINA CĂLUGĂR*

ABSTRACT

CĂLUGĂR A., 2006 - On the gamasid fauna (*Acari: Gamasina*) from the grassland ecosystems of the Moldavian Plain (Romania). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 232-235.

The paper present a comparative analysis of the gamasid mites fauna (*Gamasina* suborder) from two types of grasslands – hay fields and pastures - situated in the Moldavian Plain, the investigations being developed in 11 lawn stations. The faunistic list includes 53 species, 24 genera, and 13 families of mites. Two of these species are new for the Romanian fauna. For each species it were indicated the autecological peculiarities and the geographical distribution.

Key words: Gamasina, mites, communities, grassland ecosystems

Introduction

Gamasid mites represent a group of free mites, most of them predators, which besides the rest of soil fauna and in a close interrelation with microflora, contribute to the necromass cycling in an indirect manner (as consumers of the detrito-, zoo- and microphytophagous organisms). The transformations that occur in their life environment are reflected in structural modifications of their communities. In the Moldavian Plain it is manifested a high anthtropic pressure by the replacements of the forest surfaces with agro-ecosystems. The main objective of the paper was to put into evidence the manner in which the biodiversity and communities' structure of the gamasid mites are influenced by the anthtropic impact.

Material and methods

The investigations were performed in 11 stations: 6 pastures (Valea lui David - protected area, Vulturi, Horleşti, Sărata – Româneşti, Deleni, Uricani) and 5 hay fields (Ripiceni, Săveni, Deleni, Scobâlţeni, Valea lui David). In each of these stations 5 soil samples have been taken over. The edaphic mesofauna was extracted from samples by the Tullgren-Berlese method in the Balogh variant and then sorted out into systematic groups. In the case of gamasid mites determinations was performed up to the level of species, the abundance of each species being recorded on samples and stations; it were calculated the relative density.

Results and discussion

In the hay fields it was identify 38 species belonging to 22 genera and 12 families. The best represented are the following families: *Hypoaspididae* (4 genera and 9 species), *Rhodacaridae* (3 genera and 3 species) and *Phytoseiidae* with 2 genera and 9 species (Table 1).

Pursuing the species distribution in the analyzed hay fields it has been pointed out that the best conditions of life were those of Horleşti, Sărata and Vulturi with approximately 86% and respectively almost 81% from the total number of the signalled species. The lowest number of species was at the deteriorated hay field from Deleni. It was evidenced a series of species characteristic only for a certain hay field. So, at Vulturi it has been identified five such species, at Horleşti and Uricani four, at Sărata three and at Deleni only one. In the case of the protected area Valea lui David, all the species are common with the rest of the stations (Table 1).

Most of the species identified in the hay fields are praticolous or preferential praticolous (about 40%), and also the mesophilous and meso-hygrophilous ones. As well, it was evidenced

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silvicolous elements (22%), a normal aspect, because the investigated area belongs to silvosteppe region (Table 1) [1, 3, 4, 6].

From a zoogeographical point of view most numerous are the Palaearctic and European species with 33% from total (Table 1) [1, 3, 4, 6].

In the pastures, the number of species is insignificant less then in the hay fields (with 14%). It was identify 34 species belonging to 17 genera and 9 families, of which best represented are *Hypoaspididae* with 3 genera and 14 species and *Ascidae* with 3 genera and 5 species, followed by *Podocinidae* and *Rhodacaridae*, each of them with 2 genera and 3 species (Table 1).

Analysis of the species distribution has been pointed out that the best populated are the pastures from Valea lui David (17 species) and from Ripiceni (15 species). Only two species are common for the 5 investigated stations: *Hypoaspis praesternalis* and *Rhodacarellus silesiacus*, which mean 5.8% from the total. Also, it has been evidenced some species typical to a certain pasture: 3 for Ripiceni (*Lasioseius sp. 2, Pseudoparasitus dentatus, Leitneria sp.*), 2 for Săveni (*Pachylaelaps cf. karawaiewi, Oloaelaps placentula*) and 5 for Valea lui David (*Podocinum cf. pacificum, Asca sp., Ameroseius corbiculus, Hypoaspis cf variopilii, Rhodacarus sp*).

Analysis of the ecological spectrum shows that almost 80% from the species were represented by praticolous elements or with preferences for this kind of ecosystem (Table 1) [1, 3, 4, 6].

From zoogeographical point of view among the species, of which identification was possible, the majority are with Palaearctic and European distribution (40% from the total) (Table 1) [1, 3, 4, 6].

A comparative analysis between the faunistic spectrum of the hay fields and that of the pastures has shown that some species were founded either in natural lawns (19 species), either in the anthropized ones (14), or there are species which are common for the two types of grasslands (18 species) (Table 1).

The processing of this material led to the identification of two new species for the Romanian fauna: *Rhodacarus denticulatus,* a South European element and *Dendrolaelaspis bregetovae*, with a Holarctic areal [1, 3, 4, 6] (Table 1).

Conclusions

The study of the gamasid fauna from the lawns of the Moldavian Plain gives rise to identify a number of 53 species belonging to 24 genera and 13 families; among these there are two new species for the Romanian fauna.

The abundance of the gamasid mites and also the number of the species was variable from a station to another in accordance with the concrete bioedaphic conditions (trophic resources, pH, humidity, type of soil etc). A comparative analysis of the gamasid taxocoenosis from the ecosystems under investigation shows that the hay fields (natural lawns) offered the best conditions of life.

In the taxonomic spectrum both in the hay fields and in the pastures the same families are best represented (*Hypoaspididae* and *Rhodacaridae).*

As to the species autecological peculiarities, the faunistic list includes praticolous and preferential praticolous forms, both in the hay fields and pastures. From a zoogeographical point of view it has been identified species with Palaearctic and European distribution in the majority of the cases.

Rezumat

Lucrarea de față prezintă rezultatele unor cercetări referitoare la fauna de gamaside (*Acari: Gamasina*) din două categorii de pajişti (naturale şi antropizate) din Câmpia Moldovei. A fost analizat spectrul taxonomic, ecologic şi zoogeografic al faunei. Gamasidele, acarieni preponderent prădători, au fost studiate ca grup reprezentativ, fiind identificate în majoritate specii praticole sau cu preferințe pentru acest mediu; formele mezofile şi mezo-higrofile dețin o pondere însemnată în ansamblul faunei. S-au pus în evidență, de asemenea, şi elemente silvicole, aspect firesc, zona considerată aparținând silvostepei.

References

1. BREGETOVA N. G. and coll. 1977 - *Opredeliteli obitaiuşcih v pocive kleşcei* (*Mesostigmata)*, Izd. Nauka, Leningrad, 706 p.
2. GHILAROV M. S., KRIVOLUTSKY D. A. (eds.), 1975 – *Opredeliteli obitaiuscih v pocive klescei, Sarcoptiformes*, Izdatelstvo Nauka, Moskva, 491pp.
3. KARG W., 1971 - *Die freilebenden Gamasina (Gamasides), Raubmilben, Acari (Acarina), Milben Unterordnung Anactinochaeta (Parasitiformes)*, Veb Gustav Fischer Verlag, Jena, 475 p.
4. KARG W., 1993 - Acari (Acarina), Milben. Parasitiformes (Anactinochaeta), Cohors Gamasina Leach, Raubmilben, Tierwelt Deutschlands, Teil 59, 523 p.
5. KRANTZ G. W., 1978 - *A manual of Acarology*, second ed., Oregon State Univ., Book Stores Inc. Corvalis, 509 pp.
6. SALMANE I., KONTSCHAN J., 2005 – *Soil gamasina mites (Acari, Parasitiformes, Mesostigmata) from Hungary*. I., Latvijas Entomologs, vol. 42: 39-44.

Tab. 1 - Faunistic synopsis

Taxa	Stations											Autecological peculiarities	Geographical distribution
	hay fields						pastures						
	1	2	3	4	5	6	7	8	9	10	11		
Subclass *Acari* Nitzsch, 1818 **Order *Gamasida* Leach, 1815** **Suborder *Gamasina* Leach, 1815**													
Fam *Podocinidae* Berlese, 1916													
Podocinum Berlese, 1882													
-Podocinum cf pacificum											+		
Lasioseius Berlese, 1916													
-L. youcefi Athias Henriot, 1959							+	++			+		
-Lasioseius sp.1						+							
-Lasioseius sp.2			+	+			+						
Fam. *Ascidae* Oudemans, 1905													
Cheiroseius Berlese, 1916													
-*C. borealis* (Berlese, 1904)						++		+			+	preferential praticolous	Europe, Central and North America
- *Cheiroseius sp.*				+					+				
Asca Heyden, 1826													
- *Asca cf. bicornis*	+		++	+++	+++	+							
- *A. aphidioides* (Linné, 1758)			++	+								preferential silvicolous, mesophilous	Europe
- *A. nova* Willmann, 1939								+++	+	+	++	praticolous, eurytopic	Europe, America
-Asca sp.											+		
Leioseius Berlese, 1916													
-*L. bicolor* (Berlese, 1948)		+		+			+		+			preferential silvicolous, meso-xerophilous	Europe
Fam. *Ameroseiidae* (Berlese, 1919) Evans, 1961													
Ameroseius Berlese, 1903													
- *A. corbiculus* (Sowerby, 1806)				+							+	preferential praticolous	Palaearctic
Fam *Macrochelidae* Vitzthum, 1930													
Macrocheles Latreille, 1829													
- *Macrocheles sp.*		+											
Pachylaelaps Berlese, 1888													
- *Pachylaelaps cf. pectinifer*			+										
- *Pachylaelaps cf. karawaiewi*						+++		+					
Fam. *Hypoaspididae v. Vitzthum, 1941*													
Pseudoparasitus Oudemans, 1902													
- *Pseudoparasitus cf. dentatus*		+					+						
Ololaelaps Berlese, 1903													
- *O. sellnicki* Bregetova et Koroleva, 1964	+					+	+		+	+	+	euryplastic, mesophilous	Palaearctic
- *O. cf. placentula*		+											
Hypoaspis Canestrini, 1884													
- *H. aculeifer* (Canestrini, 1883)			+	++		+	+		+		+	euryplastic, preferential praticolous	Holarctic, South of America
-*H. praesternalis* Willmann, 1949	+		+++	+	+	+++	++	+	+	+	+	preferential praticolous	Palaearctic, Africa
- *Hypoaspis cf. incertus*			+++		+++	+			+				
- *Hypoaspis cf. austriacus*					+								
- *Hypoaspis cf .karawaewi*							+	++			+		
- *Hypoaspis cf. claviger*									++				
- *Hypoaspis cf. gracilis*									+	+			
- *Hypoaspis cf. vacua*									+				
- *Hypoaspis cf.variopili*											+		

- *Hypoaspis sp.1*			+										
- *Hypoaspis sp.2*			+										
- *Hypoaspis sp.3*							+	+					
Laelaspis Berlese, 1903													
-*L. astronomica* (Koch, 1839)		+	+									eurytopic	Palaearctic
Fam. *Phytoseiidae* Berlese, 1916													
Amblyseius Berlese, 1914													
- *Amblyseius sp1*	+	+		+++			+			+			
- *Amblyseius sp2*	+	+	+	+++	+		+		+	+	+		
- *Amblyseius sp3*		+		+						+			
- *Amblyseius sp4*				+									
- *Amblyseius cf. alpinus*							+			+	+		
Typhlodromus Scheuten,1857													
- *Typhlodromus sp.*	+		+	+									
Fam. Pseudolaelapidae Evans et Till, 1966													
Pseudolaelaps Berlese, 1916													
-*P. doderoi* (Berlese, 1910)	+	+	+									praticolous	Europe
Fam. *Rhodacaridae* Oudemans, 1902													
Rhodacarus Oudemans, 1902													
- *R. denticulatus* Berlese, 1921*	+++	++	++	+			+			++ +		thermo- xerophilous	South of Central Europe, South Europe
-*Rhodacarus sp.*											+		
Rhodacarellus Willmann, 1935													
-*R. silesiacus* Willmann, 1936.	+++	++	+			+	+	+	+	+	+	preferential praticolous, eurytopic, meso-hygrophilous	cosmopolitan
Dendrolaelaspis Lindquist, 1975													
-*D. bregetovae* Scherbak, 1978*						+						meso-hygrophilous	Holarctic
Fam. *Eugamasidae* Hirschmann, 1962													
Sessiluncus Canestrini, 1898													
-*S. hungaricus* Karg, 1974	+	+	+									silvicolous	Central Europe
Fam. *Parasitidae* Oudemans, 1901													
Pergamasus Berlese, 1903													
-*Pergamasus. cf.* crassipes	+	+		+							+		
- *Pergamasus sp.*		+						+					
*Parasitus*Latreille, 1795													
- *Parasitus sp.*								+					
Fam. *Zerconidae* Canestrini, 1891													
Prozercon Sellnick, 1943													
-*P. plumosus* Călugăr, 2004		+										preferential silvicolous	Romania
Zercon C. L. Koch, 1836													
-*Z. marinae* Călugăr i.l.	+	+++	+	+								praticolous	Romania
-*Zercon sp.*			+										
Fam. *Veigaiaidae* Oudemans, 1939													
Veigaia Oudemans, 1905													
- *V. nemorensis* (C. L. Koch, 1839)		+	+++	+								euryplastic	Palaearctic
- *V. planicola* Berlese, 1892	++	+		+							++	preferential praticolous, mesophilous	Palaearctic
-*V. exigua* (Berlese, 1916)		++										euryplastic, mesophilous	Europe
Fam. *Halolaelapidae Karg, 1965*													
Leitneria Evans, 1957													
- *Leitneria sp.*							+						

Legendă:

+++ - very abundant species (with D.r. > 5%); ++ - abundant species (with D.r. între 2-5%); + - less abundant species (with D.r. < 2%); D.r. – relative density;

*new species for the Romanian fauna; 1, 11 - Valea lui David ; 2 - Vulturi; 3 - Horleşti ; 4 - Sărata; 5 - Deleni; 6 - Uricani; 7 - Ripiceni; 8 - Săveni; 9 - Deleni;10 – Scobâlțeni.

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DIVERSITY AND DISTRIBUTION OF THE ORIBATID MITES (*ACARI, ORIBATIDA*) IN SOME LAWN ECOSYSTEMS FROM MOLDAVIAN PLAIN (ROMANIA)

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ABSTRACT

IVAN O., 2006 - Diversity and distribution of the oribatid mites (*Acari, Oribatida*) in some lawn ecosystems from Moldavian Plain (Romania). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 236-243.

The paper discusses the results of the investigations performed in a series of representative lawn ecosystems (hay fields and pastures) situated in the Moldavian Plain, concerning the fauna and coenology of the oribatid mites. The taxonomic, zoogeographic and ecological spectrum of the fauna, as well as communities' structure was analyzed, in relation with stations' peculiarities.

Key words: oribatid mites, fauna, communities, diversity, lawn ecosystems.

Introduction

Moldavian Plain, subunit of Moldavian Plateau, is located in the north-eastern part of Romania and has an 8000 km^2 surface. Nowadays, the largest part of this region is covered by cultivated crops. Forest and grassland ecosystems exist only on limited surfaces and are intensely influenced by the anthropic factor.

The present study was carried out as part of a multidisciplinary research project, financed by the Romanian Research and Education Ministry through the BIOSTAR Program. This project aims at investigating the structure and functionality of the main natural and anthropized ecosystems from Moldavian Plain, the biocoenosis – biotope interrelations and their self-adjustment capacity, being known that the anthropic pressure and the climate changes occurred in the last decades. The study under discussion finds its place in the field of recent preoccupations in knowledge and conserving the biodiversity, as part of the national natural heritage, and an important resource in the context of sustainable development.

Material and methods

Following the observations and field researches, representative ecological stations, located on the two subunits of Moldavian Plain (on the territory of Iaşi and Botoşani counties) have been selected. Natural grasslands and anthropized ones have been studied, as follows: 1. Valea lui David (protected area); 2. Vulturi; 3. Horleşti; 4.Sărata–Româneşti; 5. Deleni; 6. Uricani (hay fields); 7. Ripiceni; 8. Săveni; 9. Deleni; 10. Scobâlţeni; 11. Valea lui David (pastures).

Series of 100 cm^2 soil samples have been taken over from all such ecological stations. Edaphic mesofauna has been drawn from samples through the Tullgren - Berlese method (the variant suggested by Balogh) and selected by systematic groups. The faunistic material has been submitted to microscopic study, in order to identify the species; it has been also noted the abundance of each species, on samples and ecological stations. The primary data obtained have been processed by means of some analytic and synthetic ecological estimators: average abundance of each species (ā) and global average abundance (Ā), expressed as individuals/100cm^2 and, respectively, m^2, (ā); number of species (S) and average number of species /sample surface (S´); frequency (C) of each species; relative density (D.r.); index of ecological significance (W), expressed as classes: V and IV-edifying species, III-influent species, II and I-accompanying species; specific diversity (H(s)max, H(s), H.r.), estimated by the Shannon - Weaver equation; the adults/preadults

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ratio. The faunistic synopsis includes the list of recorded taxa, autecological peculiarities and world distribution of each species; also, for each species is indicated presence in one or another of the 11 stations, as well as relative density, as follows: +++species with more than 5% of total effectives, ++species with 2.1-5% of effectives, +species with under 2% of effectives.

Results and discussions

In its totality, the oribatid fauna, identified in all the 11 grassland ecosystems analyzed, is rich and diversified on a taxonomic level: 73 species, 56 genera, 37 families. The number of taxa recorded in the anthropized pastures is considerably smaller than in the natural grasslands (Table 1).

The weight of major groups of oribatids is similar in the two types of lawns, with a considerable representation of the picnonotic oribatids, which is a feature of forest communities [1]; this proves the fact that the analyzed ecosystems belong to the forest-steppe region.

The analysis of the zoogeographic spectrum [3, 9, 10] shows that the cosmopolitan and semi-cosmopolitan species, as well as the Holarctic ones, are more numerous in the anthropized pastures than in the natural grasslands, while the European and Palaearctic species are less represented.

As far as concerns the ecological spectrum [7, 8, 12], it should be noted the fact that grassland and forest species have a similar weight in the hay fields soil. This aspect seems characteristic for these forest-steppe grasslands. By comparison, the lawn species are more numerous in pastures, and the euryplastic species are much more numerous. The percentage of thermo-xerophilous elements is also superior (Table 1).

In the context of the present study, it has been identified a new species for the Romanian fauna, *Graptoppia (G.) parva* (Kok, 1967); besides this new species, it has been recorded a series of rare species, less cited here, in Romania: *Perlohmannia coiffaiti, Ramusella (I.) neonominata, Licneremaeus prodigiosus, Oribatella reticulata, Ceratozetes ovidianus, Lauritzenia (I.) tenuifusus, Podoribates longipes* [12].

Faunistic synopsis of the oribatid mites

Fam. *Brachychthoniidae* Thor, 1934

Poecilochthonius Balogh, 1943

-*P. spiciger* (Berlese, 1910): 1(+), 2(+), 4(+), 11(+++); mesophilous, euedaphic; Holarctic, Argentina.

Sellnickochthonius Krivolutsky, 1964

-*S. immaculatus* (Forsslund, 1942): 2(+), 7(+++), 8(+++), 10(+), 11(+); mesophilous, euedaphic; Holarctic, N Neotropical

Fam. *Eniochthoniidae* Grandjean, 1947

Hypochthoniella Berlese, 1916

-*H. minutissima* Berlese, 1904: 1(+++), 4(++); (mainly) sylvicolous, eurytopic, mesophilous; cosmopolitan

Fam. *Perlohmanniidae* Grandjean, 1954

Perlohmannia (Perlohmannia) Berlese, 1916

-*P. (P.) coiffaiti* Grandjean, 1961: 1(+); Holarctic

Fam. *Epilohmanniidae* Oudemans, 1923

Epilohmannia Berlese, 1910

-*E. cylindrica* (Berlese, 1904): 6(+), 7(+), 10(+); euedaphic, lawn species; cosmopolitan

Fam. *Euphthiracaridae* Jacot, 1930

Acrotritia Jacot, 1923

-*A. ardua* (Koch, 1841): 2(+), 4(+), 9(+), 10(+); (mainly) sylvicolous, eurytopic, mesophilous; cosmopolitan

Fam. *Nothridae* Berlese, 1896

Nothrus Koch, 1836

-*N. biciliatus* Koch, 1841: 1(+), 2(+), 4(+), 11(+); euryplastic; Holarctic

Fam. *Camisiidae* Oudemans, 1900

Camisia Heyden, 1826

-*C. horrida* (Hermann, 1804): 2(+), 3(+++); sylvicolous; Holarctic

Fam. *Hermanniellidae* Grandjean, 1934

Hermanniella Berlese, 1908

-*H. picea* (Koch, 1839): 2(+), 4(+); (mainly) sylvicolous, eurytopic, mesophilous; Holarctic

Fam. *Neoliodidae* Sellnick, 1928

Neoliodes Berlese, 1888

-*N. theleproctus* (Hermann, 1804): 1(++); (mainly) sylvicolous; semi-cosmopolitan

Fam. *Licnodamaeidae* Grandjean, 1954

Licnodamaeus Grandjean, 1931

-*L. pulcherrimus* (Paoli, 1908): 1(+), 2(+), 4(++); thermo-xerophilous; Palaearctic (except N)

Fam. *Gymnodamaeidae* Grandjean, 1954

Adrodamaeus Paschoal, 1984

-*A. italicus* (Berlese, 1916): 1(+), 4(+); central, S Europe

Fam. *Damaeidae* Berlese, 1896

Metabelba (Metabelba) Grandjean, 1936

-*M. (M.) papillipes* (Nicolet, 1855): 1(+), (++), 3(++), 4(++); eurytopic, mesophilous; Holarctic

-*M. (M.) pulverulenta* (Koch, 1839): 11(+); eurytopic, mesophilous; Holarctic

Fam. *Zetorchestidae* Michael, 1898

Microzetorchestes Balogh, 1943

-*M. emeryi* (Coggi, 1898): 4(+++); thermo-xerophilous; S Palaearctic

Fam. *Ctenobelbidae* Grandjean, 1965

Ctenobelba Balogh, 1943

-*C. pilosella* Jeleva, 1962: 1(+), 2(+); S Europe

Fam. *Damaeolidae* Grandjean, 1965

Damaeolus Paoli, 1908

-*D. ornatissimus* Csiszár, 1962: 1(+++), 2(+++), 3(+++), 4(+++), 10(+); (mainly) sylvicolous, mesophilous; S Palaearctic

Fosseremus Grandjean, 1954
-*F. laciniatus* (Berlese, 1905): 1(++), 2(+), 3(+++), 4(+), 11(+++); (mainly) sylvicolous, mesophilous; cosmopolitan
Fam. *Astegistidae* Balogh, 1961
Cultroribula Berlese, 1908
-*Cultroribula* sp.: 1(+++), 2(+++), 3(+), 4(+++), 11(+++)
Fam. *Ceratoppiidae* Kunst, 1971
Ceratoppia Berlese, 1908
-*C. bipilis* (Hermann, 1804): 1(+), 2(+), 3(+); (mainly) sylvicolous, mesophilous; Holarctic.
Fam. *Gustaviidae* Oudemans, 1900
Gustavia Kramer, 1879
-*G. microcephala* (Nicolet, 1855): 1(+); sylvicolous; Palaearctic, Mexic
Fam. *Liacaridae* Sellnick, 1928
Liacarus (Liacarus) Michael, 1898
-*L. (L.) coracinus* (Koch, 1841): 1(+), 3(+); eurytopic, mesophilous; Palaearctic
Liacarus (Dorycranosus) Woolley, 1969
-*L. (D.) punctulatus* Mihelčič, 1956: 1(++), 2(+), 3(+++), 4(+), 5(+++), 10(+); meso-xerophilous, lawn species; S Europe
Fam. *Xenillidae* Woolley et Higgins, 1966
Xenillus (Xenillus) Robineau-Desvoidy, 1839
-*X. (X.) tegeocranus* (Hermann, 1804): 6(+); euryplastic; Palaearctic
Fam. *Tectocepheidae* Grandjean, 1954
Tectocepheus Berlese, 1896
-*T. velatus* (Michael, 1880): 1(+++), 2(+++), 3(+++), 4(+++), 5(+++), 6(++), 7(+), 8(+), 10(+++), 11(+++); euryplastic; cosmopolitan
Fam. *Oppiidae* Sellnick, 1937
Oppia Koch, 1836
-*O. denticulata* (G. et R. Canestrini, 1882): 11(+); (mainly) sylvicolous, thermo-xerophilous; S Palaearctic, Antilles
Anomaloppia Subias, 1978
-*A. differens* Mahunka et Topercer, 1983: 1(++), 2(+), 3(+), 4(+++); Central, S Europe
Graptoppia (Graptoppia) Balogh, 1983
-*G. (G.) parva* (Kok, 1967): 4(+), 10(+++); xerophilous, euedaphic; S Africa, S Europe
Multioppia (Multioppia) Hammer, 1961
-*M. (M.) perfecta* Mahunka et Topercer, 1983: 1(+), 2(++), 4(+), 10(+); cultivated soils; Slovakia, Romania
Ramusella (Insculptoppia) Subias, 1980
- *R. (I.) elliptica* (Berlese, 1908): 7(++); mesophilous; S Holarctic, Costa Rica.
-*R. (I.) insculpta* (Paoli, 1908): 1(+), 2(+++), 3(++), 4(+++), 6(+++), 9(+), 11(+++); euryplastic; Palaearctic (except N).
-*R. (I.) neonominata* Subias, 2004 (=*corniculata* Ivan et Vasiliu, 1999): 1(+); E Romania
Discoppia (Cylindroppia) Subias et Rodriguez, 1986
-*D. (C.) cylindrica* (Perez-Inigo, 1965): 1(+), 2(+), 3(+), 7(+), 10(+); xerophilous, euedaphic; S Palaearctic, Central America
Medioppia Subias et Minguez, 1985
-*M. obsoleta* (Paoli, 1908): 1(+); euryplastic; Palaearctic, New Zealand, Hawaii
Microppia Balogh, 1983
-*M. minus* (Paoli, 1908): 1(++), 2(+), 7(+++), 8(+++), 10(+); euryplastic, euedaphic; cosmopolitan
-*M. minus longisetosa* Subias et Rodriguez, 1988: 6(+++); S-W Europe, Argentina
Berniniella (Berniniella) Balogh, 1983
-*B. (B.) berninii* Ivan et Vasiliu, 1997: 1(++), 2(+), 3(+), 4(+), 5(++), 11(+); (mainly) lawn species; Romania
Oppiella (Oppiella) Jacot, 1937
-*O. (O.) nova* (Oudemans, 1902): 1(+), 2(+), 11(+); euryplastic; cosmopolitan
Subiasella (Lalmoppia) Subias et Rodriguez, 1986
-*S. (L.) subiasi* (Mahunka, 1987): 6(+++), 8(+++), 9(+++); mesophilous; Central Europe
Fam. *Suctobelbidae* Jacot, 1938
Suctobelbella (Suctobelbella) Jacot, 1937
-*S. (S.) acutidens* (Forsslund, 1941): 1(+++), 2(+), 11(+); (mainly) sylvicolous, eurytopic; Holarctic, Argentina
-*S. (S.)* cf. *arcana* Moritz, 1970: 1(+), 2(+), 3(++); sylvicolous; Holarctic
-*S. (S.) perforata* (Strenzke, 1950): 1(+); sylvicolous, meso-hygrophilous; Palaearctic
- *S. (S.) subcornigera* (Forsslund, 1941): 11(+); euryplastic; semi-cosmopolitan
Fam. *Licneremaeidae* Grandjean, 1931
Licneremaeus Paoli, 1908
-*L. prodigiosus* Schuster, 1958: 2(+); Central, S Europe, Central Asia
Fam. *Phenopelopidae* Petrunkevitch, 1955
Eupelops Ewing, 1917
-*E. occultus* (Koch, 1835): 1(+), 2(+); mesophilous, lawn species; Palaearctic
Peloptulus Berlese, 1908
-*Peloptulus sp.*: 1(++), 2(+++), 4(+), 5(+++), 6(+), 7(++), 8(+), 9(+++), 10(+++), 11(+)
Fam. *Achipteriidae* Thor, 1929
Achipteria (Achipteria) Berlese, 1885
-*A. (A.) acuta* Berlese, 1908: 1(+); mesophilous; Holarctic
-*A. (A.) coleoptrata* (Linné,1758): 6(++), 8(+++), 11(+); eurytopic, mesophilous; Holarctic
Fam. *Oribatellidae* Jacot, 1925
Oribatella Banks, 1895
-*O. reticulata* Berlese, 1916: 1(+++), 3(++); S Holarctic
Tectoribates Berlese, 1910
-*T. ornatus* (Schuster, 1958): 1(++), 4(+); eurytopic, lawn species; Palaearctic, Argentina, Uruguay
Fam. *Ceratozetidae* Jacot, 1925
Ceratozetes (Ceratozetes) Berlese, 1908

-*C. (C.) conjunctus* Mihelčič, 1956: 1(+), 2(+), 3(+), 8(+++); meso-xerophilous; Mediterranean

-*C. (C.) mediocris* Berlese, 1908: 1(+++), 2(++), 4(++); mesophilous, thermophilous lawn species; semi-cosmopolitan

-*Ceratozetes (C.) ovidianus* Vasiliu et Călugăr, 1981: 3(++); S-E Romania

<u>*Murcia*</u> Koch, 1835

-*M. nova* Sellnick, 1928: 7(+); Holarctic

<u>*Viracochiella (Latilamellobates)*</u> Shaldybina, 1971

-*V. (L.) incisella* (Kramer, 1897): 3(+), 10(+), 11(+); mesophilous, lawn species; Palaearctic

<u>*Zetomimus (Protozetomimus)*</u> Perez – Iñigo, 1990

-*Z. (P.) acutirostris* (Mihelčič, 1957): 5(+); lawn species; S Europe

Fam. *Punctoribatidae* Thor, 1937

<u>*Punctoribates*</u> Berlese, 1908

-*P. moldavicus* Vasiliu et Călugăr, 1976: 3(+); mesophilous, lawn species; Romania

-*P. punctum* (Koch, 1839): 1(+++), 6(++), 9(+++), 11(+++); eurytopic, lawn species; semi-cosmopolitan

Fam. *Mochlozetidae* Grandjean, 1960

<u>*Podoribates*</u> Berlese, 1908

-*P. longipes* (Berlese, 1887): 10(+); Holarctic

Fam. *Oribatulidae* Thor, 1929

<u>*Oribatula (Oribatula)*</u> Berlese, 1896

-*O. (O.) pannonica* Willmann, 1949: 1(++), 2(+), 3(++), 6(++), 8(+), 9(+), 11(+); lawn species; Palaearctic

<u>*Oribatula (Zygoribatula)*</u> Berlese, 1916

-*O. (Z.) connexa* Berlese, 1904: 7(++), 9(+); eurytopic, frequent in cultivated soils; subtropical

-*O. (Z.) frisiae* (Oudemans, 1900): 1(++), 2(+++), 3(++), 4(+); (mainly) saxicolous, arboricolous; Holarctic

-*O. (Z.) undulata* Berlese, 1916: 7(++), 8(++), 9(+); xerophilous, tolerant for soil's salinity;

Fam. *Liebstadiidae* J. et P. Balogh, 1984

<u>*Liebstadia*</u> Oudemans, 1906

-*L. pannonica* (Willmann, 1951): 1(+), 2(+), 3(+), 4(+), 5(+++), 7(+), 10(+++); (mainly) lawn species; Holarctic

Fam. *Scheloribatidae* Grandjean, 1933

<u>*Scheloribates (Scheloribates)*</u> Berlese, 1908

-*S. (S.) barbatulus* Mihelčič, 1956: 1(+), 2(++), 3(+++), 6(+); thermo-xerophilous; S Palaearctic

-*S. (S.) fimbriatus* Thor, 1930: 6(+++), 9(+++), 11(+); populates cultivated soils; cosmopolitan

-*S. (S.) labyrinthicus* Jeleva, 1962: 2(++), 3(+), 5(+++), 6(+++), 7(+++), 8(+++), 9(+++), 10(+++), 11(++); eurytopic lawn species; S and S-E Europe

-*S. (S.) laevigatus* (Koch, 1835): 4(+); euryplastic; semi-cosmopolitan

Fam. *Protoribatidae* J. et P. Balogh, 1984

<u>*Protoribates (Protoribates)*</u> Berlese, 1908

-*P. (P.) capucinus* Berlese, 1908: 1(+++), 2(+++), 3(+++), 4(+++), 5(++), 6(+), 10(+++), 11(+); eurytopic, mesophilous; cosmopolitan

Fam. *Haplozetidae* Grandjean, 1936

<u>*Indoribates (Haplozetes)*</u> Willmann, 1935

-*Indoribates (Haplozetes)* sp.: 2(+++), 3(++)

<u>*Lauritzenia (Incabates)*</u> Hammer, 1961

-*L.(I.) tenuifusus* (Berlese, 1916): 1(+), 3(+); Mediterranean

<u>*Peloribates (Peloribates)*</u> Berlese, 1908

-*P. (P.) europaeus* Willmann, 1935: 3(+); Holarctic

Fam. *Galumnidae* Jacot, 1925

<u>*Pergalumna*</u> Grandjean, 1936

-*P. myrmophila* (Berlese, 1914): 1(+); S Palaearctic

-*P. nervosa* (Berlese, 1914): 3(+), 7(+), 10(+); eurytopic, mesophilous; Holarctic, S Africa.

<u>The coenological analysis</u> undertaken on the basis of the global structural parameters of the oribatid communities shows their differentiation through both qualitative and quantitative aspects, depending on the bio-edaphic conditions of the ecological station, particularly in comparison with the pressure of the anthropic factor. In this way, in the soil of the hay fields from Valea lui David (nature reserve), the oribatids reach the maximum value of their global abundance, related to the entire series of analyzed ecosystems. We deal with a complexely structured community, formed by a large number of species; most of these species find here optimal biotic and abiotic conditions, so that their horizontal distribution is well balanced. This is proved by the high value of the S' index (average number of species/sample surface), as well as by the high number of constant and euconstant species (30 from 44). This equilibrium state between biotope and biocoenosis is also proved by the high values of the specific diversity (maximal, real, and relative), the distribution of effectives on species tending to equitability. The above mentioned aspects point out the fact that the ecosystem under discussion is in a climax stage, and the oribatids, as part of the decomposers subsystem, faithfully reflect this situation, proving their bioindicating value.

The edifying and influent species (classes V, VI, and III of ecological significance) have a large number, cumulating 88.41% form the community's individuals. Among these species we can mention typically lawn forms, such as *Ceratozetes mediocris, Punctoribates punctum, Oribatula pannonica, Liacarus (D.) punctulatus, Tectoribates ornatus;* besides them, there exists a number of forest species or species which prefer forest soils, such as: *Damaeolus ornatissimus, Hypochthoniella minutissima, Neoliodes theleproctus,* as well as elements with a large ecological plasticity - *Tectocepheus velatus, Protoribates capucinus*.

The oribatid communities from Vulturi, Horleşti and Sărata stations present qualitative similarities with Valea lui David, but have a more reduced density, number of species, and diversity (Table 2). Thus, at Vulturi station, the global average abundance represents only 56% of the value recorded in Valea lui David; in the hay fields from Horleşti and Sărata, the ratio is approximately 22% and 54%, respectively, compared to the protected area. The number of species in these 3 stations is 18-40% smaller than that in the hay fields from Valea lui David, and the specific diversity is diminished accordingly. Consequently, the minimum anthropic impact, exerted through the exploitation of these lawns (by mowing), transposes at the oribatid communities level through a density and diversity reduction, at the same time.

The species mentioned in the case of the community in Valea lui David as edifying and influent ones have high values of the ecological significance index in the other 3 stations too. We should also mention: *Oribatula (Z.) frisiae* (species which prefers the arboricolous and saxicolous habitats, therefore resistant to aridity), *Microzetorchestes emeryi* (a thermo-xerophilous species, frequent and abundant in Sărata, signaled with this occasion in the most northern point), *Scheloribates barbatulus, Ceratozetes conjunctus, Licneremaeus prodigiosus* (elements thermo-xerophilous, of southern fauna).

In the grassland at Deleni (5), periodically pastured, the oribatids present the smallest density and number of species from the entire series of analyzed ecosystems. The community has a reduced specific diversity and is entirely restructured; euryplastic species and grassland elements, tolerant to changes in the edaphic environment, induced through pasturing, have an edifying value.

In the framework of the present study, besides the slope lawns analyzed, we have investigated a wet hay field, from the major riverbed of Bahlui (Uricani station); similar grasslands can also be found, as intrazonal formations, in the meadows of other waters which cross the Moldavian Plain (Jijia, Başeu). In different edaphic conditions in such grasslands, compared to the slope lawns (excessive humidity, different degrees of salinisation), the global average abundance of oribatids is relatively low, so that their weight in the mesofauna system is modest. The number of recorded species is also, relatively low, and the most adapted ones (a very low number) have large effectives; among these, we should mention *Scheloribates fimbriatus* (frequently mentioned in cultivated soils), *Subiasella (L.) subiasi* (frequent and abundant in wet habitats from the Danube Delta), *Scheloribates labyrinthicus* (eurytopic lawn species).

Tab. 1 – Comparative analysis of the oribatid mites' fauna

		NATURAL LAWNS	ANTHROPIZED LAWNS
Taxonomic spectrum	Families	35	22
	Genera	52	34
	Species	65	39
Weight of the major groups	Archoribatida	12.3%	12.8%
	Euoribatida – picnonoticae	46.15%	46.15%
	Euoribatida – poronoticae	41.5%	41.02%
Zoogeographic spectrum	European species	22.73%	15.4%
	Palaearctic species	24.24%	17.9%
	Holarctic species	25.75%	28.2%
	cosmopolitan, semi- cosmopolitan species	19.7%	28.2%
	species with southern areal	27.27%	28.2%
Ecological spectrum	lawn species	18.18%	23.1%
	sylvicolous species	16.66%	12.8%
	euryplastic species	10.6%	25.6%
	thermo-xerophilous species	12.12%	15.4%

Within the series of pastured grasslands, the stations in Săveni, Scobâlțeni and David Valley are slope grasslands, while Ripiceni-Cinghinia and Deleni (9) grasslands vegetate in more humid stations, on saline soils. In Săveni pasture soil, the oribatids reach the maximum density (compared to the rest of the investigated stations), but the number of species is reduced (Table 2). The edifying and influent species represent 70% of the total number and gather 98% of the community's individuals. These facts prove that some bio-edaphic factors (such as humidity, some groups of soil microflora) seasonally reach levels which create optimal conditions, thus favoring the growth of effectives of the species majority. Among the species with a high ecological significance, we should mention:

Scheloribates labyrinthicus, Ceratozetes conjunctus (lawn elements), *Sellnickohthonius immaculatus, Microppia minus* (micro-phytophagous, euedaphic forms), *Subiasella (L.) subiasi, Achipteria coleoptrata* (a mesophilous species, with a high ecological plasticity). It is also important to mention that *Oribatula (Zygoribatula) undulata* is euconstant and subdominant, being in this case an influent species, which indicates a certain degree of soil salinisation.

In Scolbâlțeni and Valea lui David stations, the oribatid communities have similar values for the global structural parameters, but they are different from a qualitative point of view, as specific composition, inclusive that of the edifying groupings (Table 2). Thus, from the totality of identified species, only 6 are common to the two above mentioned stations, and, in the case of the edifying groupings, the only common species is *Tectocepheus velatus* (euryplastic element). Besides this, at Scobâlțeni were recorded also *Liebstadia pannonica* (preferentially lawn species), *Graptoppia (G.) parva* (xerophilous, euedaphic), *Scheloribates labyrinthicus* (lawn eurytopic species); at Valea lui David, we have registered high values of the ecological significance index for the following species: *Punctoribates punctum* (lawn eurytopic species), *Fosseremus laciniatus* (mesophilous, prefers forest habitats), and *Ramusella (I.) insculpta* (euryplastic species). The edifying species gather 72.4% of the effectives at Scolbâlțeni and 67 % at Vale lui David. Among the influent species, we should mention: *Podoribates longipes* (a rare species, less cited in Romania), *Scutovertex sculptus* (lawn species), *Discoppia (C.) cylindrica* (xerophilous, euedaphic). In the case of these two pastures, it should be noted that the number of species and the specific diversity have the highest values; moreover, the specific composition and the presence of some quite rare faunistic elements, prove that the anthropic pressure is lower in these stations, due to a rational exploitation of grassland.

The oribatid communities from Ripiceni and Deleni (9) have distinct characteristics, even though some bio-edaphic factors (high level of humidity, soil salinity) are common to both stations. So, in Ripiceni station, the global abundance is very low, representing only 36.3% from the value registered in Deleni, but it has a higher number of species and a higher specific diversity (Table 2). The reduced value of S' index (average number of species/ sample) shows that, in Ripiceni, there is a nonuniformity of life conditions within the station and/or an edaphic factor has become limiting. The reduced number (only four) of euconstant and constant species sustains this idea; the rest of the species are accessory or, most of them, accidental ones. Among the edifying species, we should note: *S. labyrinthicus., P. punctum, M. minus, S. immaculatus, S. (L.) subiasi,* with high values of the ecological significance in the above mentioned stations as well; we should add to the last mentioned *Scheloribates fumbriatus*, species cited in cultivated soils. We should also mention the fact that *Oribatula (Zygoribatula) undulata* and *O. (Z.) connexa* are found in the soil of the two pastures (in Ripiceni station, they are influent species), indicating a high content of salts in soil.

Therefore, in pastured grasslands it is recorded a considerable diminution of the species richness and of the specific diversity, despite the fact that the global average abundance has values comparable to those in the hay fields. Therefore, these communities are less complex, less stable, and they do not completely revaluate the resources furnished by the habitat.

Another noteworthy aspect regarding the oribatid communities is that species such as *S. labyrinthicus, P. punctum* or *A. coleoptrata* have numerous populations in all the analyzed pastures, being cited as potential intermediary hosts to the anoplocephalid tapeworms. Consequently, we consider those parasitoses with a high potential of transmission to the herbivores.

Conclusions

The study of oribatids, a representative detritomicrophytophagous group of mites, has shown that grassland ecosystems from Moldavian Plain are populated by a rich and taxonomically diversified fauna. The fauna comprises, in close proportions, lawn and forest elements, illustrating the belonging of these ecosystems to the forest-steppe region; though in its entirety, fauna has a mesophilous character, it is noteworthy to notice the presence of some thermo-xerophilous species, some of them being for the first time recorded at this latitude.

The oribatid communities present in the soil of the slope hay fields have similarities on a structural aspect, though the global density records great variations depending on the stational conditions. In the wet hay fields (situated in the major riverbeds) the oribatid communities are clearly different, not only quantitatively, but also qualitatively, because the density, the number of species and the specific diversity have more reduced values. The pasturing, practiced even periodically on some surfaces, determines a considerable diminution of abundance, as well as of the number of species and of the specific diversity. In the stations where an ecological factor becomes limiting (excessive humidity, the content of salts in the soil), the density of oribatids is relatively low, which causes their modest weight in the mesofauna system. The number of species is also relatively low, and the most adapted ones, very few, have great effectives.

Rezumat

Lucrarea cuprinde rezultatele cercetărilor întreprinse într-o serie de ecosisteme praticole, naturale şi antropizate, situate în Câmpia Moldovei, privind fauna şi structura comunităţilor de oribatide. S-au analizat spectrul taxonomic, zoogeografic şi ecologic al faunei, precum şi structura oribatidocenozelor, în relaţie cu particularităţile staţiunilor. Fauna identificată este bogată şi diversificată sub aspect taxonomic - 73 specii, 56 genuri, 37 familii. Se regăsesc, în proporţii apropiate, elemente praticole şi silvicole, ilustrând apartenenţa acestor ecosisteme la zona de silvostepă; deşi în ansamblul său, fauna are un caracter mezofil, este remarcabilă prezenţa unor specii termo-xerofile, pentru unele dintre ele fiind prima semnalare la această latitudine.

Comunităţile de oribatide din solul fâneţelor de coastă prezintă similitudini sub aspect structural, în pofida faptului că densitatea globală înregistrează variaţii mari în funcţie de condiţiile staţionale. Oribatidocenozele din fâneţele umede de albie majoră se diferenţiază net, atât prin parametrii de ordin cantitativ, cât şi calitativ, densitatea, numărul de specii şi diversitatea specifică având valori mai reduse. Păşunatul, practicat chiar şi periodic pe unele suprafeţe, determină o diminuare semnificativă atât a abundenţei cât, mai ales a numărului de specii şi a diversităţii oribatidelor.

References

1. AOKI J., 1983 - *Analysis of Oribatid communities by relative abundance in the species and individual numbers of the three major groups (MGP-Analysis)*, Bul. Inst. Env. Sci. Tech., Yokohama National University, 10(1): 171-176.
2. CĂLUGĂR M., 1973 – *Fauna oribatidelor (Acari: Oribatei) din rezervaţia naturală Valea lui David*, Ocrot. nat., t. 17, nr. 2: 177-181.
3. GHILAROV M. S., KRIVOLUTSKY D. A. (eds.), 1975 – *Opredeliteli obitaiuscih v pocive klescei, Sarcoptiformes*, Izdatelstvo Nauka, Moskva, 491pp.
4. IVAN O., CĂLUGĂR A., 2004 - *On the diversity and distribution of edaphic mites (Acari: Gamasida, Oribatida) in some saxicolous, low - altitude habitats in the North – Eastern Romania*, An. Compl. Muz. al Bucovinei – Suceava, XVI – XVII: 151-168.
5. IVAN O., 2005 - *Diversitatea taxonomică şi cenotică a oribatidelor (Acari, Oribatida) în ecosisteme praticole din lunca Prutului, în condiţiile bioedafice modificate prin lucrările complexe de amenajare*, al X-lea Simpozion de Microbiologie şi Biotehnologie, Ed. Corson, Iaşi: 475-482.
6. PEREZ-INIGO C., 1993 - *Acari, Oribatei, Poronota,* in Fauna Iberica, vol.3, Ramos, M.A. et al. (eds.), Museo Nacional de Ciencias Naturales, CSIC, Madrid: 320 pp.
7. RAJSKI A., 1967 - *Autecological-Zoogeographical Analysis of Moss Mites (Acari, Oribatei) on the Basis of Fauna in the Poznań Environs.* Part I, Bull.Entom.de Pologne, t. XXXVII (1): 69-166.
8. RAJSKI A., 1968 - *Autecological-zoogeographical analysis of moss mites (Acari, Oribatei) on the basis of fauna in the Poznań environs.* Part II, Fragmenta Faunistica, Polska Akademia Nauk, t.XIV(12): 277-405.
9. SUBIAS L.S., 2004 – *Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes, Oribatida) del mundo (1758-2002),* Graellsia, 60 : 3-305.
10. SUBIAS L.-S., GIL-MARTIN J., 1997 - *Systematic and biogeographic checklist of oribatids from Western Mediterranean (Acari, Oribatida)*, Ann.Mus.Civ.St.Nat. "G.Doria", XCI: 459-498.
11. VASILIU N., CALUGAR M., HUTU, M., 1973 - *Contribution a la connaissance des Oribates, hôtes intermediaires de Moniezia des pâturages du bassin de la riviere Jijia*, Archiva Veterinaria, t. IX, fasc. I-II: 205-214.
12. VASILIU N., IVAN O., VASILIU, M., 1993 - *Conspectul faunistic al oribatidelor (Acarina, Oribatida) din România*, Anuarul Muz. Naţ. al Bucovinei, Suceava, fasc. Şt. nat., XII: 3-82.
13. VASILIU N., IVAN O., 1997 - *Effect of the draining and upturning measures on the oribatid community from the lawn ecosystem of the Prut water meadow*, Studii şi Cercetări, Biologie, Univ. Bacău, 2: 163-172.

Tab. 2 – Global structural parameters of the oribatid mites communities

Types of lawns	Stations	Ā	S	S'	Adults/ preadults	Specific diversity			Edifying species
						$H(S)_{max}$	H(S)	H. r.	
Natural lawns	Valea lui David	13,040	44	26.6	36.2	5.4594	5.1696	94.69	*Cultroribula* sp., *Damaeolus ornatissimus, Ceratozetes mediocris, Tectocepheus velatus, Punctoribates punctum, Suctobelbella acutidens, Oribatella reticulata*
	Vulturi	8,600	36	21.8	11.3	5.1699	4.5092	87.22	*Tectocepheus velatus, Cultroribula* sp., *Ramusella (I.) insculpta, Damaeolus ornatissimus, Zygoribatula frisiae*
	Horleşti	3,360	29	11.8	42	4.8579	4.2866	88.24	*Liacarus (D.) punctulatus, Tectocepheus velatus, Camisia horrida*
	Sărata	8,260	26	11.6	10.3	4.7004	3.6939	78.59	*Cultroribula* sp., *Anomaloppia differens, Tectocepheus velatus, Damaeolus ornatissimus, Microzetorchestes emeryi*
	Deleni	1,660	8	4.2	27.6	2.9999	2.4283	80.95	*Scheloribates labyrinthicus, Peloptulus* sp., *Tectocepheus velatus*
	Uricani	3,680	15	6	12.3	3.9069	2.995	76.66	*Scheloribates fimbriatus, Subiasella (L.) subiasi, Scheloribates labyrinthicus, Microppia minus longisetosa, Ramusella (I.) insculpta*
Pastures	Ripiceni	2,060	14	5.2	6.35	3.8073	2.8784	75.6	*Microppia minus, Sellnickochthonius immaculatus, Scheloribates labyrinthicus*
	Săveni	15,120	10	7.8	13.82	3.3219	2.6665	80.27	*Subiasella (L.) subiasi, Scheloribates labyrinthicus, Microppia minus, Achipteria coleoptrata, Sellnickochthonius immaculatus, Ceratozetes conjunctus*
	Deleni	5,660	10	6.6	10.32	3.3219	2.2735	68.44	*Punctoribates punctum, Scheloribates labyrinthicus, Scheloribates fimbriatus, Subiasella (L.) subiasi, Peloptulus* sp.
	Scobâlţeni	4,760	18	9.2	6.93	4.1699	3.389	81.27	*Liebstadia pannonica, Graptoppia (G.) parva, Scheloribates labyrinthicus, Peloptulus* sp., *Tectocepheus velatus*
	Valea lui David	6,300	21	8	6	4.3923	3.3558	76.4	*Punctoribates punctum, Tectocepheus velatus, Fosseremus laciniatus, Ramusella (I.) insculpta*

Legend: Ā-global average abundance, individuals/m^2; S-number of species; S'-average number of species/sample; $H(S)_{max}$-maximum specific diversity; H(S)-real diversity; H. r. - relative diversity (%); * protected area.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE STUDY OF INVERTEBRATE FAUNA IN TOMATO CROPS ON BIOLOGICAL AND CONVENTIONAL AGRICULTURE

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ABSTRACT

TOMOZEI B., CALIN M., AMBARUŞ S., STOIAN L., POPA M, C., 2006 – The study of invertebrate fauna in tomato crops on biological and conventional agriculture. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol.21: 244-247.

The trials were performed in the experiment fields at Vegetable Research Station Bacău, regarding the setting up an intensive and biological agriculture under the particular condition of the Moldavia. The invertebrate fauna from biological and conventional tomato crops have 47 species from 25 families in 7 orders. From these species were identified: 27 phytophagous species; 17 zoophagous species; 2 omnivorous species; 1 coprophagous specie.In conventional crops were identified 18 phytophagous species, 10 predatory species and 1 omnivorous species. The pests in biological tomato crops were under economic threshold. In conventional crop the key pests were: aphids (*Macrosiphum euphorbiae* Hott et Fris, and *Aulacorthum solani,* Kalt.), onion trips (*Thrips tabaci* Lind), leafhopper (*Macrosteles laevis* Rib., *Empoasca solani* Curtis and *Eupteryx* sp.), Colorado beetle (Leptinotarsa decemlineata Say.). Aphides and trips were the key pests in the seedling stage. For controlling these pests was necessary to apply two treatments with Confidor 0.075 % and Mospilan 0.015 %.Colorado beetle was the key pest in open field, after the seedling was transplanted in to the field. It was applied two treatments with Victenon 0.05 % and Mospilan 0.02 %. Leafhopper population was abundant in open field of flowers, fructify and ripening stages of tomato plants, but was not necessary the application of chemical treatments.

Key words: invertebrates, tomato crops, pest control

Introduction

The tomato crops are an ecosystem with complex interrelationships between plants, animals and cultural practices (Baicu and Săvescu, 1986).

Every species of beneficial fauna may cause mortality specific pest of tomato, often maintain satisfactory control of the dangerous species (Perju et al., 1989).

Transposing this concept in practice depends on knowing the factors composing the agro-ecosystems. These factors are divided into two categories. The first category encloses beneficial fauna (Maria Calin, 2004) and the second category encloses, the type of culture was: intensive or biological tomato crops (I.F.O.A.M., 1993, Stoian, 2004).

Pests damage tomato by feeding on root, foliage or fruit or by spreading virus diseases. Obviously those feeding within the fruit are a concern to the processor or marketer.

The fauna of tomato pests is various. Rogojanu and Perju (1979), found 24 species of pests. Sorensen et. al., (2002) mentioned in U.S.A. 17 key species with economically importance.

In Bacau exist three critical periods when insect damage. In April aphids have been usually established colonies in tomato seedlings. By early July, populations of aphides are growing in tomato field. By meddle August is the most critical period, because the pests have reached population which can spread the viruses. A control program must implemented begin with seedling stage and continually it in field crops. Among the elements of this program are determined of the fauna species and monitoring of the degree attack of key pests in tomato. These subjects will be presented in this paper.

Material and methods

The trials were performed in the experiments field at Vegetable Research Station Bacău, regarding the setting up an intensive and biological agriculture under the particular condition of the Moldavia.

1. Range of Arthropods species

* "IonBorcea" Natural Sciences Museum Complex
** Vegetable Research and Development Station

The trial was performed in following variants:

V1 – Unirea sort of tomato in biological agriculture;

V2 – Unirea sort of tomato in conventional agriculture.

The results obtained through direct observation of collecting insects with Pitfall traps, double yellow traps, and insect sweep net. The following aspects have been mainly examined: range of useful, damage and indifferent Arthropod in the biological and conventional crops.

2. Attack monitoring of key pests

The attack of pest was described by the degree, frequency and intensity attack.To achieve this goal, it has been made observations, regarding the frequency (F %) and intensity (I %) of attack in the conditions of natural infestation. The data was used for estimate the degree attack and for timely control programs which can be implemented in applications of treatments. The obtained data were correlated with the stages of plants.

Results and discussions

1. Range of Arthropods species from studiated crops.

The invertebrate fauna from biological and conventional tomato crops has 47 species from 25 families in 7 orders (Fg. 1) such as:

- 1specie from one family in order Aranea;
- 1specie from one family in order Orthoptera;
- 7 species from 3 families in order Hemiptera;
- 1specie from one family in order Neuroptera;
- 23 species from 10 families in order Coleoptera;
- 3 species from 3 families in order Hymenoptera;
- 11 species from 6 families inFrom these species were bean identified:

- 27 phytophagous species: *Gryllotalpa gryllotalpa*, *Macrosiphum euphorbiae* Hott et Fris, *Aphis gossypii* Glover, *Aulacorthum solani, Macrosteles laevis* Rib., *Empoasca solani* Curtis, *Eupteryx* sp. *Lygus pratensis* L.,*Longitarsus tabidus* Fabr., *Epitrix pubescens* Koch, *Altica oleracea* L., *Phyllotetra atra* F., *Phyllotetra undulata* Kutsch., *Psylliodes chrysocephala* L., *Meligethes aeneus* F., *Agriotes ustulatus* Schall., *Acanthoscelides obtectus, Mylaena intermedia* Er., *Apion* sp., *Sericoderus lateralis* Gyll., *Athalia rosae* L., *Chloromyia formosa* Scop., *Musca domestica* L., *Tipula oleracea* L., *Phytomyza* sp., *Pegomyia nigritarsis* Ztt., *Heleodromyia immaculate* Hal.;

- 17 zoophagous species: *Alopecosa sp., Broscus cephalotes, Cicindela germanica* L., *Carabus cancellatus* Illig., *Carabus violaceus* L., *Chrysopa carnea* Steph, *Atanygnathus terminalis* Er., *Propylaea 14 punctata* L., *Coccinella 7 punctata* L., *Adonia variegata*, *Melanostoma scalare* Fabr., *Sphaerophoria scripta* L., *Epistrophe balteata* Deg., *Syrphus ribesii* L., *Melanostoma melinum* L., *Bracon anthracinus* Nees., *Cotesia* sp.;

- 2 omnivorous species: *Pseudoophonus rufipes* De Geer, *Harpalus tardus;*

- 1 coprophagous species from *Aphodius* sp.

In conventional crops were identified 18 phytophagous species, 10 predatory species and one omnivorous species .

In conventional crop, with Pitfall traps were trapping the following species: *Broscus cephalotes, Cicindela germanica, Carabus cancellatus, Pseudoophonus rufipes, Athalia rae.* In biological agriculture crop were captured with Pitfall trap: *Alopecosa* sp., *Cicindela gmanica, Carabus cancellatus, Carabus violaceus, Pseudoophonus rufipes, Harpalus tardus, Haltica oleracea, Gryllotalpa gryllotalpa, Eupteryx sp., Macrosiphum euphorbiae.*

Dominants were *Broscus cephalotes*, *Carabus cancellatus* and *Cicindella germanica*.

In biological crop were identified: 17 phytophagous species, 13 predatory species, 2 omnivorous species and one coprophagous specie.

Dominants were: *Alopecosa sp.* from Araneae, *Carabus cancellatus, C. violaceus, Cicindela germanica, Pseudoophonus rufipes*, *Harpalus tardus* from Coleoptera.

With sweep net were captured from conventional tomato crops 9 species: *Chrysopa carnea, Macrosiphum euphorbiae, Aulacorthum solani* Kalt., *Empoasca solana, Eupteryx sp.*, *Coccinella 7 punctata, Athalia rosae, Epistrophe balteata, Melanostoma melinum* (fig. 4). In biological tomato crops were collected: *Chrysopa perla, Empoasca solana, Lygus pratensis, Adalia variegata, Eupteryx sp., Macrosiphum euphorbiae*, *Haltica oleracea, Phyllotetra atra, Psylliodes chrysocephala*, *Epistrophe balteata, Chloromyia formosa* (Fg. 2.)

The pests in biological tomato crops were under economical threshold.

In conventional crops the key pests were: aphids (*Macrosiphum euphorbiae* Hott et Fris, *Aulacorthum solani,* Kalt.), onion trips (Thrips tabaci Lind), leafhopper *Macrosteles laevis* Rib., *Empoasca solani* Curtis, *Eupteryx* sp.), Colorado beetle (*Leptinotarsa decemlineata* Say.).

2. Attack monitoring of key pests

Degree attack of pests in the conventional tomato crops was high in the seedling stage (Table 1).

Aphides and trips were the key pests in the seedling stage. For controlling these pests was necessary to apply two treatments with Confidor 0.075 %.

Colorado beetle was the key pest in open field, after the seedling was transplanted in field. It was applied two treatments with Victenon 0.05 % and Mospilan 0.02 %

Leafhopper population was abundant in open field in flowering, fructify and ripening stages of tomato plants, but was not necessary the application of chemical treatments.

Conclusions

The trials were performed in the experiments field at Vegetable Research Station Bacău, regarding the setting up an intensive and biological agriculture under the particular condition of the Moldova.

The invertebrate fauna from biological and conventional tomato crops has 47 species from 25 families in 7 orders such as: one specie from one family in order Aranea; one specie from one family; in order *Orthoptera*; 7 species from 3 families, in order *Hemiptera*; one specie from one family, in order Neuroptera; 23 species from 10 families in order *Coleoptera*; 3 species from 3 families in order *Hymenoptera*; 11 species from 6 families in order *Diptera*.

From these species, in biological tomato were identified: 27 phytophagous species; 17 zoophagous species; 2 omnivorous species; 1 coprophagous species.

In conventional crops were identified 18 phytophagous species, 10 predatory species and one omnivorous species.

The pests in biological tomato crops were under economic threshold.

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Aphides and trips were the key pests in the seedling stage. For controling of them was necessary to apply two treatments with Confidor 0.075 % and Mospila 0.015%.

Colorado beetle was the key pest in open field, after the seedling was transplanted in field. It was applied two treatments with Victenon 0.05 % and Mospilan 0.02 %

Leafhopper population was abundant in open field in flowering, fructify and ripening stages of tomato plants, but was not necessary the application of chemical treatments.

References

1. BAICU T., SĂVESCU A., 1986 - *Sisteme de combatere integrată a bolilor şi dăunătorilor pe culturi*. Ed Ceres, Bucureşti, 159 - 172.
2. CALIN M., 2004 - *Ghidul recunoaşterii şi controlului dăunătorilor plantelor gumicole cultivate în agricultură biologică*. Ed. Tipoactiv Bacau.
3. PERJU T., MATILDA LĂCĂTUŞU, PISICĂ C., ANDRIESCU I., MUSTAŢĂ GH., 1989 - *Entomofagii şi utilizarea lor în protecţia integrată a agroecosistemelor horticole*. Ed. Ceres, Bucureşti, 15 - 51.
4. STOIAN L., 2004 – *Ghid pentru cultura biologică a legumelor*. Ed. Tipoactiv Bacau.
5. SORENSEN K. A., BAKER J. R., CARTER C.C., 2002 - *Key to tomato pests*. The North Carolina Cooperative Extension Service.

Tab. 1 - Degree attack of pests in the conventional tomato crop

No. crt.	Stage of plants	Frequency attack (F%)	Intensity attack (I%)	Degree of attack (%)	Comments
0	1	2	3	4	5
Aphids					
1	Seedling	21,4	16,3	3,5	It was applied two treatments with Confidor 0,075 % and Mospilan 0.015%
2	Seedling after transplanting in field	0,1	0,1	0,1	No chemical treatment
3	Flowering	0,1	0,2	0,1	No chemical treatment
4	Flowering and fructify of plants	0,1	0,1	0,1	No chemical treatment
5	Flowering, fructify and ripening	0,1	0,1	0,1	No chemical treatment
Trips					
1	Seedling	22,3	8,1	1,8	It was applied two treatments with Confidor 0,075 % and Mospilan 0.015%
2	Seedling after transplanting in field	0	0	0	No chemical treatment

0	1	2	3	4	5
3	Flowering	0	0	0	No chemical treatment
4	Flowering and fructify of plants	0	0	0	No chemical treatment
0	1	2	3	4	5
5	Flowering, fructify and ripening	0	0	0	No chemical treatment
Leafhopper					
1	Seedling	0	0	0	No chemical treatment
2	Seedling after transplanting in field	0	0	0	No chemical treatment
3	Flowering	9,8	6,9	0,7	No chemical treatment
4	Flowering and fructify of plants	8,5	6,5	0,6	No chemical treatment
5	Flowering, fructify and ripening	3,7	1,4	0,1	No chemical treatment
Colorado beetle					
1	Seedling	0	0	0	No chemical treatment
2	Seedling after transplanting in field	6,1	15,4	0,9	It was applied two treatments with Victenon 0.05 % and Mospilan 0.02 %
3	Flowering	0	0	0	No chemical treatment
4	Flowering and fructify of plants	0	0	0	No chemical treatment
5	Flowering, fructify and ripening	0	0	0	No chemical treatment

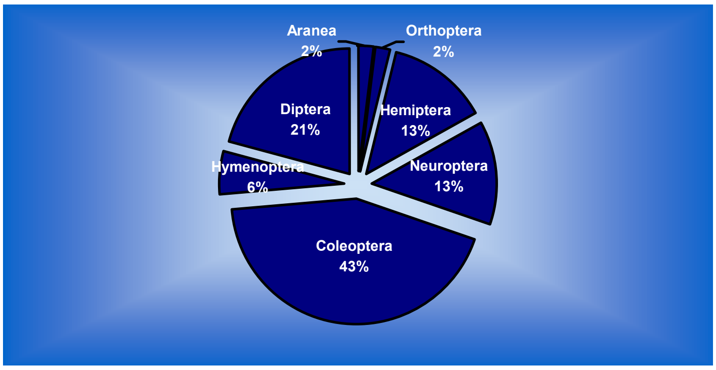


Fig. 1 – Percentage of invertebrate orders in studied tomato crops

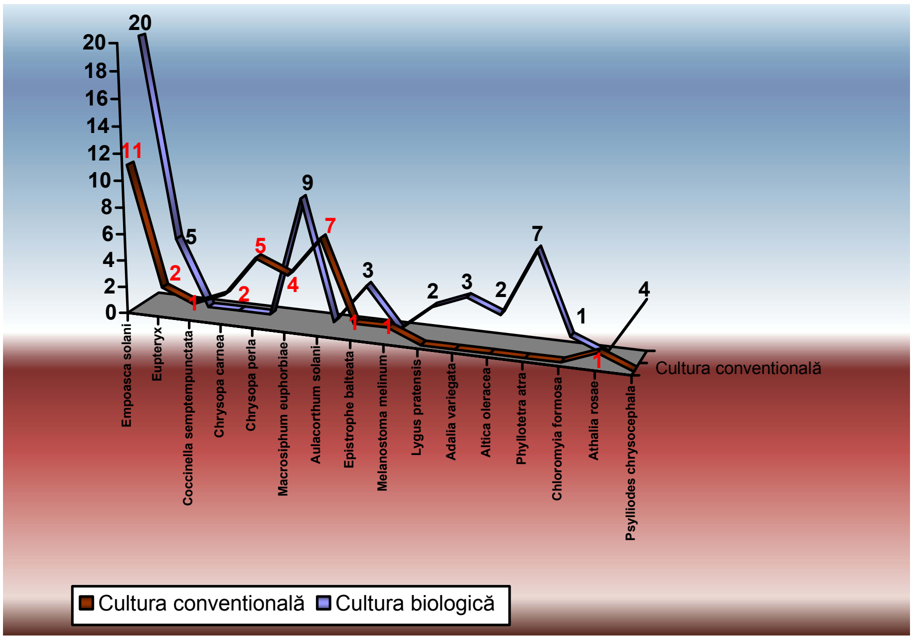


Fig. 2- Abundance and dominance of captured species by sweep net in biological and conventional tomato crop

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 248 – 250

THE STUDY REGARDING THE DECREASE OF SLUGS ATTACKS IN INPUT AGRICULTURE

MARIA CĂLIN*, MARCELA FĂLTICEANU*, BOGDAN TOMOZEI**, CAMELIA MIHAELA POPA*

ABSTRACT

CALIN M., FALTICEANU M., TOMOZEI B., POPA C.M., 2006 - The study regarding the decrease of slugs attacks in input agriculture. *Studii şi Comunicări*, Compl. Muz. St. Nat. “Ion Borcea”, 21: n - m.

The trials were performed at the Vegetable Research and Development Station Bacău – România, during 2005 – 2006. The subject was monitoring and control of slugs in climbing bean and Petunia seedlings. The intensity of slug attack was 20, 7 % in the period of plant emergence. Intensity of slug attack was also high (15, 4 %) in this stage.

Slug attack decreased after controlling them with feeding traps under economical level. The efficiency in attract of slugs was variable. The beast variant in climbing bean was Optimol + potato. This variant attracted 2 slugs/ trap. In Petunia, the most variant was Optimol with apple. It trapped 7 slugs/ trap in Petunia seedlings.

Key words: monitoring**,** slugs attacks, climbing bean and *Petunia* seedlings, Vegetable Research and Development Station Bacău.

Introduction

Specifically grown technology of vegetables (frequency of irrigation, densities of plants, luxuriant growing) are creating optimal conditions for multiplication and development of slugs (Calin Maria, 2005).

Grossu (1978) mentioned in Romania the following species pest of slugs in the gardening: *Arion subfuscus* D., *A. circumscriptus* J., A. *hortensis* F. (*Arionidae family*); *Deroceras agreste* L., *D. reticulatus* M., *D. sturanyi* S., *Limax maximus* L., *L. flavus* L., *Lehmannia marginata* M. (*Limacidae family*); *Milax marginatus* D., *M. valachicus* G.et L., *M. kusceri* W. (*Milacidae family).*

Among the slug species Savescu mentioned as economical pest, the small grey slug *Agriolimax agrestis* – synonym of *Deroceras agrestis* (Cândea, 1984). The small grey slug was found in all Europe and other continents (Boguleanu and colab., 1980; Burch and Van Devender, 1980, Cândea, 1984, 1986; Calin Maria, 2004, 2005), .This slug was in all Romanian areas in which are cultivated vegetable and flower. It developed damages in irrigated crops and in the years with abundant rainfall.

The control strategies in input agriculture used the prevention and limitation of *Deroceras* attack. This strategies offered the optimal protection of crop plants and they had a minimal impact above the environment (Speiser şi colab., 2001). To achieve these goals was necessary to use the preventive and curative methods for limitation of pest attack.

Materials and methods

The trials were performed at Vegetable Research and Development station Bacau, during 2005 – 2006. The 2006 year was favorable for attack of snails without shells because was a year very rich in rainfall. For this reason the paper will present the data obtained this year.

The observations and experiments were made in the port grains of climbing bean (Aurie de Bacau variety) and in the seedlings of Petunia (mixture of varieties).

1. Attack monitoring of without shells snails

The attack of pest was described by the degree of frequency and intensity.

To achieve this goal, it has been made observations, regarding the frequency (F %) and intensity (I %) of attack in the conditions of natural infestation. The data was used for estimate the degree attack and for timely control programs which can be implemented in applications of treatments.

* Vegetable Research and Development Station
** “Ion Borcea” Natural Sciences Museum Complex

The obtained data were correlated with stage of plants.

2. The study of efficiency of feeding traps for slug control

The trial was made in following variants:

V30.1 – Optimol + potato

V30.2 – Optimol + carrot

V30.3 – Optimol + apple

V30.4 – Untreated control

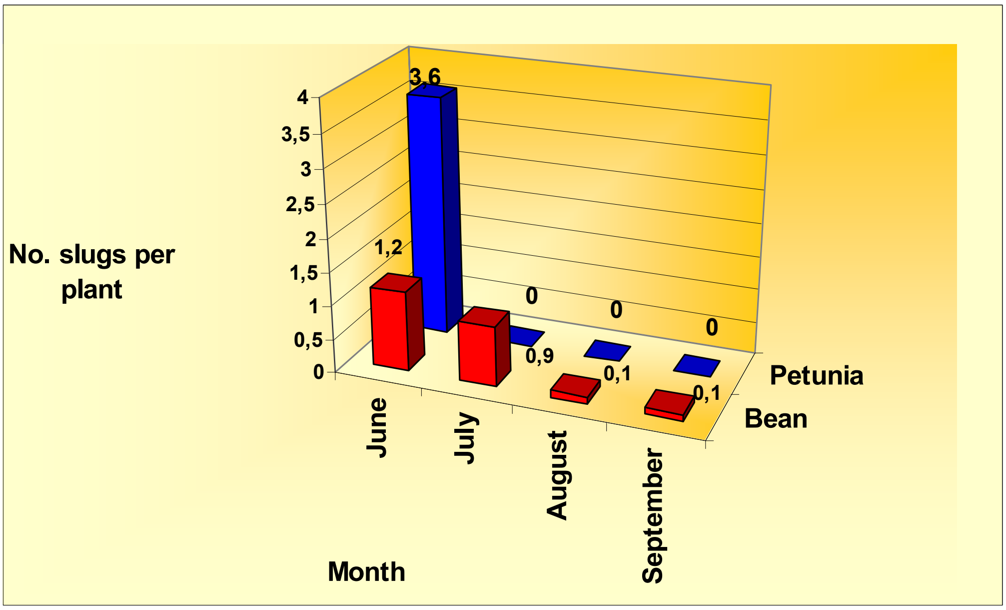
The traps were putted near the plants with slugs attack. In each morning the traps were checked and the slugs were counted and removed.

Results and discussions

Monitoring attack of snails without shells

In the stage of plant emergence the number of slugs/plant was high (fig. 1). Also the frequency of pests attack (table 1) was high - 20, 7%.

After the control of slugs with feeding traps the frequency of attack decreased at 7,9 % in the stage of growing and flowering of the bean and 0,1%, in stage of flowering, fructify and maturity of this crop.



Tab. 1 - Slug's degree of attack at the climbing bean, Aurie de Bacau

No. crt.	Stage of plants	Frequency attack (F%)	Intensity attack (I%)	Degree of attack (%)	Comments
0	1	2	3	4	5
Without shells snails					
1	Emergence of plants	20,7	15,4	3,2	Feeding traps were putted in attack area
2	Growing and flowering of plants	7,9	6,7	0,5	Feeding traps were putted in attack area
3	Flowering and fructify of plants	0,1	0,1	0,1	Not applied the control treatment
4	Flowering, fructify and maturity	0,1	0,1	0,1	Not applied the control treatment

The use of feeding traps in emergence phase of bean decreased the number of snails without shell per plant, from 1,2% to 0, 2%.

The intensity of attack decreased from 15,4 % in emergence stage, till 0,1 % in stages of flowering, fructification and maturity of this crop.

The study of efficiency of feeding traps for snails without shells

The feeding traps captured a different number of pests according with specie of plants (table 2).

Tab. 2 - The captures of feeding traps

Variant	Attack			
	Frequency (F%)	Intensity (I%)	Degree of attack (DA %)	
Climbing bean				
V30.1 – Optimol + potato	20,7	15,4	3,2	**2**
V30.2 – Optimol + carrot	23,2	14,9	3,5	1
V30.3 – Optimol + apple	21,6	16,4	3,5	1
V30.4 – Untreated	22,7	14,2	3,2	-
Petunia				
V30.1 – Optimol + potato	**100**	7,3	7,3	3
V30.2 – Optimol + carrot	100	6,2	6,2	1
V30.3 – Optimol + apple	100	5,9	5,9	7
V30.4 – Untreated	100	7,1	7,1	-

It is observed that Optimol + potato variant have captured more pests in climbing bean crop – 2 ex. per trap (table 2).

In the seedling of Petunia the Optimol + apple variant has captured more number of pests per trap 7 ex. per trap.

Conclusions

Monitoring attack of snails without shells

In the stage of plant emergence number of slugs on a plant was high – 3,6 %per plant and the frequency of pests attack was 20,7%.

The use of feeding traps in emergence phases of bean, decreased the number of snails without shells per plant, from 1,2% to 0,2%.

The intensity of attack decreased from 15,4 % in emergence stage, until 0,1 % in stages of flowering, fructification and maturity of this crop.

The study of efficiency of feeding traps for snails without shells

The Optimol + potato variant have captured more pests in climbing bean crop – 2 ex. per trap.

In the seedling of Petunia the Optimol + apple variant has captured a big number of pests - 7 ex. per trap.

References

1. BURCH JB, VAN DEVENDER AS. 1980 - *Identification of eastern North American land snails: The Prosobranchia, Opisthobranchia and Pulmonata* (*Actophila*). Walkerana 1: 33-80.
2. CĂLIN M., 2004 - *Dăunătorii pilifagi ai legumelor şi combaterea lor în agricultură biologică*. Editura Diagonal Bacău.
3. CĂLIN M., 2004 - *Ghidul recunoaşterii şi controlului dăunătorilor plantelor legumicole cultivate în agricultură biologică*. Editura Tipo Activ, Bacău.
4. CÂNDEA E., 1984 - *Dăunătorii legumelor şi combaterea lor*. Editura Ceres.
5. CÂNDEA E., 1986 - *Combaterea nechimică a dăunătorilor la legume*. Editura Ceres.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 251 – 256

CONTRIBUTIONS TO THE DISTRIBUTION KNOWLEDGE OF SOME ORTHOPTERA SPECIES (INSECTA: ORTHOPTERA) FROM EASTERN ROMANIA

IONUŢ ŞTEFAN IORGU*, ELENA IULIA PISICĂ**

ABSTRACT

IORGU ŞT. I., PISICĂ I.E., 2006 - Contributions to the distribution knowledge of some orthoptera species (Insecta: Orthoptera) from Eastern Romania. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 251-256.

This paper presents four new orthoptera species for Moldavia Region: *Decticus albifrons, Pezotettix giornae, Pteronemobius heydeni, Glyptobothrus macrocerus* and three new orthoptera species for Dobrougea region: *Bicolorana roeselii, Bicolorana bicolor* and *Glyptobothrus mollis*. Also, we present the collecting, biology, ecology and distribution data of the seven species.

Key words: orthoptera, Moldavia, Dobrougea, distribution.

Introduction

The orthoptera fauna from Romania belongs to the Palearctic region and is divided in nine districts. Moldavia and Dobrougea belong to four fauna districts: Oriental Carpathians District, Moldavian District, Danubian District and Dobrougean District.

The Moldavian District has the largest number of orthoptera species - 114 species, meaning 64% of all the species from Romania. Until now, only 110 species were cited from this district. During our researches in the years 2004-2006, we have found four more species for this district: *Decticus albifrons, Pteronemobius heydeni, Pezotettix giornae* and *Glyptobothrus macrocerus*.

The Oriental Carpathians District has the lowest number of orthoptera species from all the districts. Only 69 species, meaning 38,7% of the species from our country can be found here.

The Danubian District covers a large part of Muntenia and Southern Moldavia. 94 species were identified untill now, totalising 52,8% of the orthoptera fauna. We have found one new species for this district: *Glyptobothrus macrocerus*.

Dobrougean District – 109 species were identified meaning 61,2% of the total orthoptera species from our country. We have found three new species for this district: *Bicolorana roeselii, Bicolorana bicolor* and *Glyptobothrus mollis*.

Material and methods

The sampling of the material was made manually and sweeping the vegetation with the entomological net. The specimen identification was made according to external morphology and genitalia using identification keys made by Kis (1976 and 1978), Bellman & Luquet (1995), Baur et al. (2006) and the nomenclature used in this paper is adopted from Orthoptera Species File On Line (online version February 2007: *http://osf2.orthoptera.org/O/entry/HomePage.aspx*).

Results and discussions

Suborder Ensifera
Family Tettigoniidae
Subfamily Tettigoniinae
Tribe Decticini
***Decticus albifrons* (Fabricius, 1775)**

Is a large species, predominantly insectivorous. It is a thermo-xerophilous species, living mostly in xerophilous grasslands with gramineous bushes and low vegetation. The adults can be found from the end of June until the middle of October. (Fig. 1)

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Distribution: It is a Circummediterranean species, known from Southern Europe, Asia Minor and Northern Africa. In Romania, it can be found mostly on the littoral area. We have collected the species from Valea lui David as a new species for Moldavia.

It is very strange to find *Decticus albifrons* at Valea lui David, so far from the littoral and the Danube Delta. But in this area we have found other interesting isolated mediterranean elements like: *Poecilimon brunneri, Pezottetix giornae, Bradyporus dasypus, Bradyporus macrogaster* and *Onconotus servillei,* which are also far from their usual territory. (Fig. 2)

Material: 2♀♀, Valea lui David (IŞ), 05.07.2006; 12♂♂ 7♀♀, Eforie Nord (CT), 19.08.2006; 3♂♂, Constanța (CT), 05.08.2006; 2♂♂ 1♀, Vadu (CT), 13.09.2005; 21♂♂ 13♀♀, Agigea (CT), 20.08.2006; 3♂♂, Caraorman (TL), 3.08.2006; 6♂♂ 2♀♀, Histria (CT), 05.08.2006; 1♂, Jurilovca (TL), 15.09.2005.

***Bicolorana (Bicolorana) bicolor bicolor* (Philippi, 1830)**

It is a medium size, euribiont and omnivorous species. It lives in mesophilous, higro-mesophilous and meso-xerophilous grassland biotopes. Adults are present from June until October. (Fig. 3)

Distribution: It is a Eurosiberian species, very common in the central and northern part of our country. In Moldavia, is one of the most common orthoptera species. We have collected a single male from Dobrougea at Garvăn, being a new species for this region. (Fig. 4)

Material: 1♂, Garvăn (TL), 10.09.2005; 56♂♂ 45♀♀, Paşcani (IŞ), 04.07.2006; 36♂♂ 27♀♀, Iaşi, 26.07.2005; 31♂♂ 20♀♀, Codrii Paşcanilor (IŞ), 13.07.2006; 13♂♂ 7♀♀, Soci (IŞ), 02.08.2005; 29♂♂ 19♀♀, Hanu Ancuței (NT), 22.07.2005; 38♂♂ 25♀♀, Agapia (NT), 25.07.2006; 12♂♂ 15♀♀, M-rea. Neamț (NT), 26.07.2006; 5♂♂ 1♀, Ceahlău (NT), 10.09.2006; 12♂♂ 5♀♀, Rarău (SV), 09.07.2006; 24♂♂ 16♀♀, Hârboanca (VS), 20.07.2006; 9♂♂ 3♀♀, Bârnova (IŞ), 13.09.2006; 29♂♂ 20♀♀, Valea lui David (IŞ), 07.09.2006; 12♂♂ 10♀♀, Şendriceni (BT), 23.08.2006; 4♂♂ 1♀♀, Horleşti (IŞ), 16.07.2006; 6♂♂ 2♀♀, Crasna (VS), 21.06.2005; 2♂♂, Codăeşti (VS), 22.06.2005; 24♂♂ 17♀♀, Huşi (VS), 29.09.2004; 11♂♂ 5♀♀, Breana-Roşcani (IŞ), 21.06.2005; 3♂♂, Oancea (GL), 21.06.2005; 5♂♂ 1♀, Gârboavele (GL), 22.06.2005; 2♂♂ 5♀♀, Tomeşti (IŞ), 05.10.2005; 29♂♂ 22♀♀, Putna (SV), 24.08.2006.

***Bicolorana (Roeseliana) roeselii roeselii* (Hagenbach, 1822)**

It is a medium size, omnivorous species. It is a mesophilous species which prefers xero-mesophilous and xerophilous grassland biotopes. Adults are present from June to October. (Fig. 5)

Distribution: It is a Holarctic species, known from all the country except the high mountains and Dobrougea. In Moldavia is quite frequent, from Dobrougea we have collected it from Garvăn together with *Bicolorana bicolor*, being a new species for Dobrougea. (Fig. 6)

Material: 1♂, Garvăn (TL), 10.09.2005; 21♂♂ 10♀♀, Paşcani (IŞ), 04.07.2006; 13♂♂ 9♀♀, Iaşi, 26.07.2005; 19♂♂ 14♀♀, Codrii Paşcanilor (IŞ), 13.07.2006; 5♂♂, Soci (IŞ), 02.08.2005; 3♂♂ 1♀, Hanu Ancuței (NT), 22.07.2005; 8♂♂ 6♀♀, Agapia (NT), 25.07.2006; 19♂♂ 10♀♀, M-rea. Neamț (NT), 26.07.2006; 1♂, Ceahlău (NT), 09.09.2006; 2♂♂, Rarău (SV), 31.08.2005; 7♂♂ 3♀♀, Hârboanca (VS), 20.07.2006; 28♂♂ 17♀♀, Bârnova (IŞ), 13.09.2006; 6♂♂ 2♀♀, Valea lui David (IŞ), 05.07.2006; 2♂♂, Şendriceni (BT), 23.08.2006; 4♀♀, Horleşti (IŞ), 16.07.2006; 1♂, Crasna (VS), 21.06.2005; 5♂♂ 2♀♀, Codăeşti (VS), 22.06.2005; 12♂♂ 5♀♀, Huşi (VS), 29.09.2004; 3♂♂, Breana-Roşcani (IŞ), 21.06.2005; 1♂♂, Oancea (GL), 21.06.2005; 1♀, Gârboavele (GL), 22.06.2005; 16♂♂ 11♀♀, Tomeşti (IŞ), 05.10.2005.

Family Gryllidae
Subfamily Nemobiinae
Tribe Pteronemobiini

***Pteronemobius (Pteronemobius) heydeni heydeni* (Fischer, 1853)**

It is a small species, hygrophilous and geophilous which prefers marshland biotopes. We can find adults from May till September. (Fig. 7)

Distribution: It is a Circummediterranean species; in our country it is frequent in Southern Muntenia, Dobrougea and quite rare in Transylvania. It is a new species for Moldavia. (Fig. 8)

Material: 3♂♂ 2♀♀, Hagieni (CT), 11.08.2005; 9♂♂ 2 ♀♀, Caraorman (TL), 03.08.2006; 1♂, Isaccea (TL), 10.09.2005; 2♂♂, Jurilovca (TL), 10.09.2006; 3♂♂, Codăeşti (VS), 15.09.2005; 14♂♂ 9♀♀, Iaşi, 15.07.2006

Suborder Caelifera

Family Acrididae
Subfamily Catantopinae
Tribe Pezotettigini

***Pezotettix giornae* (Rossi, 1794)**

It is a medium size species, meso-xerophilous and thermophilous. It lives in various biotopes, but it prefers meadows and lawns. Adults can be found from July to November. (Fig. 9)

Distribution: It is a Circummediterranean species, very common in the southern part of our country and rare in the north. In Moldavia it wasn't cited in literature before 1980 (Mandru, 1980). We found it for the first time in the Southern and Eastern part of Moldavia, being quite frequent in this area. We believe this species to be in areal extension because of the numerous sites where we have found it in great number. (Fig. 10)

Material: 2♂♂, Valea Teilor (TL), 07.09.2005; 1♂, Greci (TL), 06.09.2005; 1♂1♀, Isaccea (TL), 10.09.2005; 12♂♂ 8♀♀, Agigea (CT), 20.10.2006; 3♂♂, Hagieni (CT), 13.08.2006; 5♂♂ 2♀♀, Allah-Bair (CT), 11.09.2005; 3♂♂ 5♀♀, Cernavodă (CT), 13.08.2006; 8♂♂ 4♀♀, Fântânița-Murfatlar (CT), 16.08.2005; 13♂♂ 9♀♀, Valea lui David (IŞ), 07.09.2006; 25♂♂ 31♀♀, Iaşi, 21.09.2005; 1♂ 1♀, Bârnova (IŞ), 09.11.2004; 5♂♂ 6♀♀, Huşi (VS), 29.09.2004; 2♂♂ 5♀♀, Hanu Conachi (GL), 22.10.2006; 13♂♂ 8♀♀, Hârboanca (VS), 04.10.2006; 1♂, Paşcani (IŞ), 24.09.2006.

Fig. 1. *Decticus albifrons,* male (Agigea, 20.08.2006)

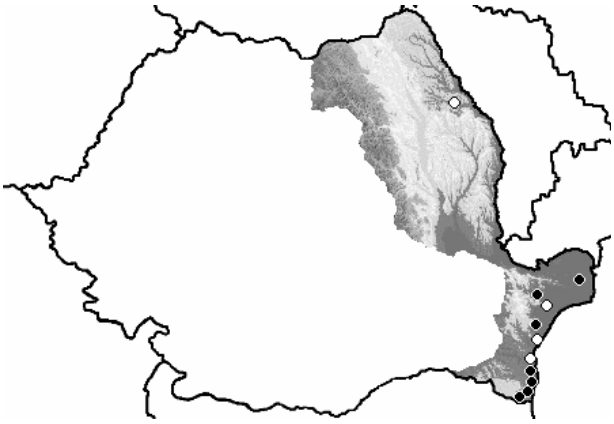

Fig. 2. Distribution of *Decticus albifrons* in Eastern Romania *

Fig. 3. *Bicolorana bicolor,* male (Paşcani, 04.07.2006)

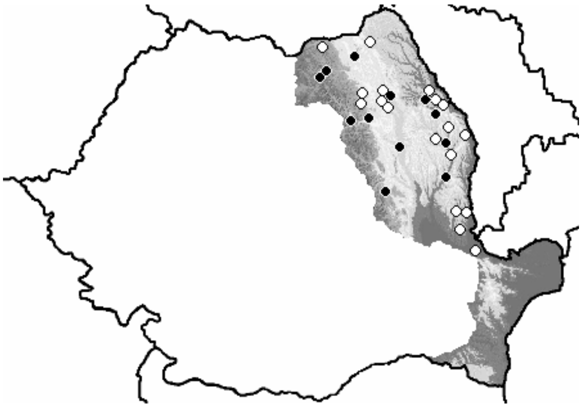

Fig. 4. Distribution of *Bicolorana bicolor* in Eastern Romania
*

Fig. 5. *Bicolorana roeselii,* male (Codrii Paşcanilor, 13.07.2006)

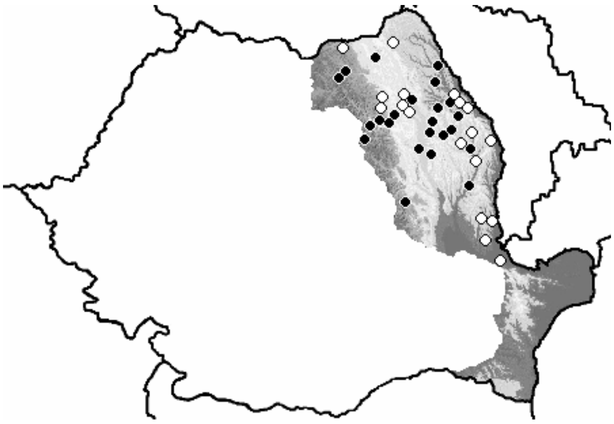

Fig. 6. Distribution of *Bicolorana roeselii* in Eastern Romania *

*** Picture legend:**
●literature data;
○ original data

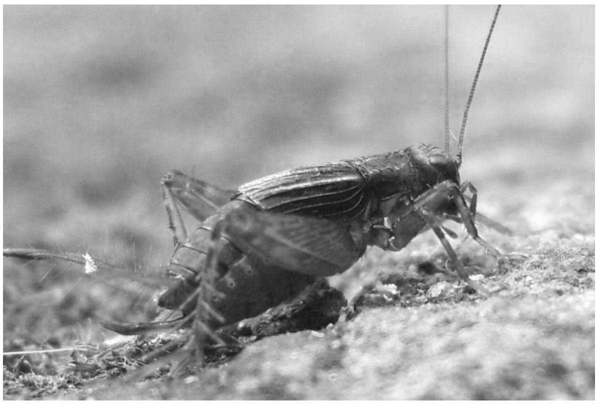

Fig. 7. *Pteronemobius heydeni,* female (Iaşi, 15.07.2006)

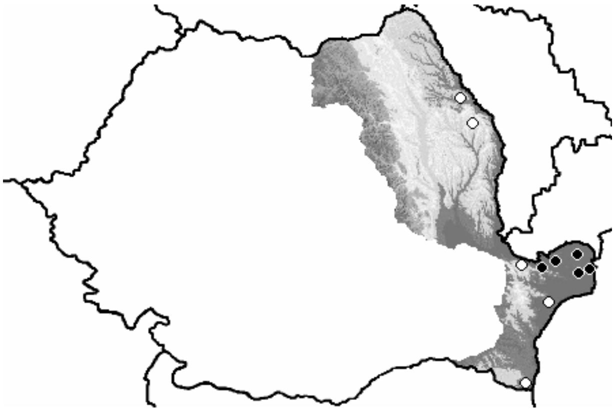

Fig. 8. Distribution of *Pteronemobius heydeni* in Eastern Romania*

Fig. 9. *Pezotettix giornae,* female (Agigea, 20.10.2006)

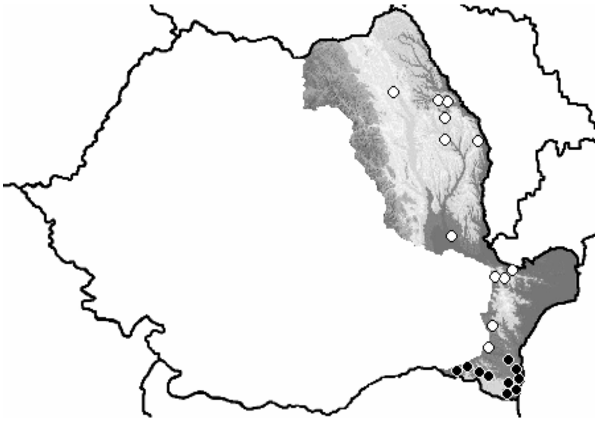

Fig.10. Distribution of *Pezotettix giornae* in Eastern Romania*

Fig. 11.*Glyptobothrus mollis*, male (Valea lui David, 07.09.2006)

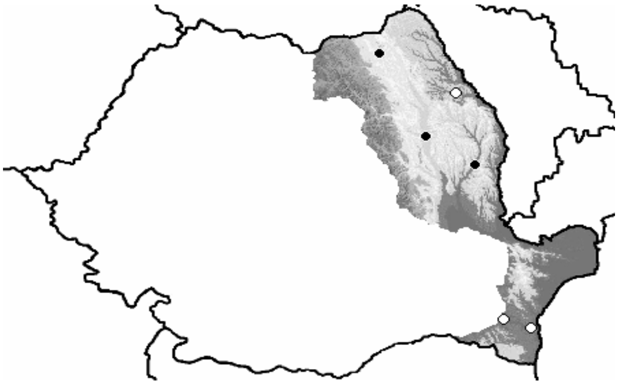

Fig. 12. Distribution of *Glyptobothrus mollis* in Eastern Romania*

*** Picture legend:**

●literature data;

○ original data

Fig. 13. *Glyptobothrus macrocerus*, male (Hârboanca, 20.07.2006)

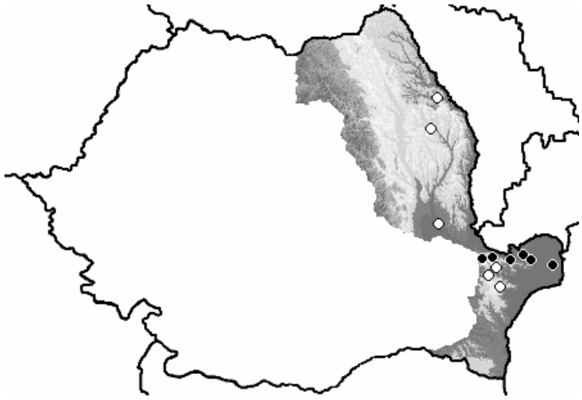

Fig. 14. Distribution of *Glyptobothrus macrocerus* in Eastern Romania*

Subfamily Gomphocerinae
Tribe Gomphocerini

***Glyptobothrus mollis mollis* (Charpentier, 1825)**

It belongs to *G. biguttulus-brunneus-mollis* group, species which are very hard to differentiate morphologically, but very easy by stridulation. It is an euribiont species. Adults can be found from June till November. (Fig. 11)

Distribution: It can be found throughout Europe and Palearctic Asia. In Romania is more frequent in Tisa Plain and Transsylvania; in Dobrougea and Moldavia is very rare and localized. We have collected the species at Cernavodă and Valul lui Traian for the first time for Dobrougea. (Fig. 12)

Material: 42♂♂ 35♀♀, Valea lui David (IŞ), 07.09.2006; 1♂, Valul lui Traian (CT), 17.08.2006; 3♂♂, Cernavodă (CT), 13.08.2006.

***Glyptobothrus macrocerus purpuratus* (Voroconvskij, 1927)**

It is a small size species, xerophilous and praticolous which prefer xerophilous meadows near the forest. (Fig. 13)

Distribution: It is an Eurosiberian species, known from Eastern Romania, the northern part of the Black Sea until Kazahstan. In Romania is quite frequent in Northern Dobrougea and in Moldavia it is found isolated. It is a new species for Moldavia. (Fig. 14).

Material: 1♀, Alba (TL), 07.09.2005; 1♂, Institutul Celic Dere (TL), 08.09.2005; 1♂, Horia (TL), 15.09.2005; 9♂♂ 8♀♀, Niculiţel (TL), 10.09.2005; 1♂, Caraorman (TL), 03.08.2006; 26♂♂ 15♀♀, Hârboanca (VS), 20.07.2006; 1♂, Iaşi, 15.07.2006; 2♂♂, Hanu Conachi (GL), 22.10.2006.

*** Picture legend: ●literature data; ○ original data**

Conclusions

Following the researches that we made in eastern part of Romania during 2004-2006, we have found four new species for Moldavia Region: *Decticus albifrons, Pezotettix giornae, Pteronemobius heydeni, Glyptobothrus macrocerus* and three new species for Dobrougea: *Bicolorana roeselii, Bicolorana bicolor* and *Glyptobothrus mollis.*

Collecting of *Decticus albifrons* from Valea lui David is particularly important because it is a Mediterranean species, and in our country has a restricted distribution to the litoral area and the Danube Delta.

Pteronemobius heydeni is a species which lives in marshes, a biotope which is difficult to access by men. This is the reason why the distribution of this species is little known in our country.

We consider *Pezotettix giornae* as being in extension of areal because it was considered as missing from Moldavia and we have found it in Siret plain and Bahlui Plain, being quite numerous in this area.

Glyptobothrus macrocerus, cited in our country only from Northern Dobrougea, has its limit of its areal further north in the forests and meadows of the Central Moldavian Plane.

Bicolorana roeselii, Bicolorana bicolor and *Glyptobothrus mollis,* found for the first time in Dobrougea, are euribiont species which proves that this area must be further studied very throughly.

Rezumat

Această lucrare prezintă patru specii noi de ortoptere pentru regiunea Moldovei: *Decticus albifrons, Pezotettix giornae, Pteronemobius heydeni, Glyptobothrus macrocerus* şi trei specii noi pentru regiunea Dobrogei: *Bicolorana roeselii, Bicolorana bicolor* şi *Glyptobothrus mollis*. Sunt

prezentate datele de colectare, date asupra biologiei, ecologiei şi arealului celor şapte specii.

Aknowledgements

Our sincere aknowledgements to Mr. Prof. Dr. Gheorghe Mustaţă for his guiding and his advice. We also want to thank Mrs. PhD. Fellow Laura Păiş for her help on the field and her advice.

References

1. BAUR B., BAUR H., ROESTI C., ROESTI D., THORENS P., 2006 - *Sauterelles, Grillons et Criquets de Suisse*. Haupt, Berne.
2. BELLMAN H., LUQUET G., 1995 - *Guide des Sauterelles, Grillons et Criquets d'Europe Occidentale*. Delachaux et Nieslé, Lausanne (Suisse), Paris.
3. KIS B., 1976 - Cheie pentru determinarea ortopterelor din România. Partea I Subord. Ensifera. *Muzeul Brukenthal Şt. Nat. – Stud. şi Com.*, vol. 20: 123 – 166.
4. KIS B., 1978 - Cheie pentru determinarea ortopterelor din România. Partea II Subord. Caelifera. *Muzeul Brukenthal Şt. Nat. – Stud. şi Com.*, vol. 22: 233 – 276.
5. MÎNDRU C., 1980 - Fauna de ortoptere din Fâneţele Seculare de la Valea lui David – Iaşi. *Analele Ştiinţifice ale "Universităţii Al. I. Cuza" din Iaşi (serie nouă), Secţ. II, a. Biologie*, tomul XXVI: 93 – 95.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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DIVERSITY AND SOME ECOLOGICAL ASPECTS OF THE SPECIES OF CARABIDAE (COLEOPTERA, CARABIDAE) IN THE CLOVER CROP ECOSYSTEM FROM THE NORTH OF MOLDAVIA (SUCEAVA AND BOTOSANI COUNTIES)

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ABSTRACT

TURCULEŢ A., VARVARA M., 2006 - Diversity and some ecological aspects of the species of Carabidae (Coleoptera: Carabidae) in the clover crop ecosystem from the north of Moldavia (Suceava and Botoşani counties). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 257-267.

The present paper deals with some ecological aspects concerning the epigeic ground beetles from the clover crop ecosystem from Suceava and Botoşani Counties. It presents the alpha diversity of the ground beetles, the variation of the relative abundance, the Shannon index of the coenoses, evenness, and the main ecological requirements of the species, the general characterisatics of the coenosis of ground beetles as concerns the classes of ecological requirements.reproduction,moisture,biotopes, food and geographical distribution.

Key words: Clover crop, relative abundance, dominance, Shannon index, evenness, main ecological requirements.

Introduction

Moldavia is a zoogeographical region (Bella Kiss, 1970) characterized by a continental climate, with annual average temperature between 7 and 9° C., annual average precipitations between 450 and 650 mm. In the past, the hilly region of Moldavia was covered by deciduous forests, from south to north: oak,common oak and beech, then replaced by meadows and cultivated land.This mention contributes to the understanding of the evolution and adaptation of the fauna to the new conditions existing in the agroecosystems.

Within the ecological conditions of the Suceava County,results on the ecological aspects concerning the epigeic fauna of Carabidae in the potato,maize and clover crops, published: (VARVARA, BRUDEA, 1983); (VARVARA, DONESCU, DASCALU, 1990); (VARVARA, BRUDEA, 1999); (VARVARA, 2001)

The purpose of this paper is to present a synthesis on the alpha and gama diversity of the epigeic ground beetles, the variation of their relative abundance of the species, the Shannon index and the evenness, the degree of similitude between sites of collection of the material, according to Sörrensen's coefficient and to characterize the coenosis of Carabidae in the clover crop in the north of Moldavia as concerns the main ecological requirements

Material and methods

The present paper is based on the personal scientific material of ground beetles collected by one of the authors (TURCULET, 2005) and BRUDEA (1977,1978).

The collection of the ground beetles was made by adequate methods to their biotopes, biology and ecology. The most used, classical and standard method in collecting the ground beetles is the utilization of pitfalls with preseving liquid. This method permits the qualitative and quantitative collection of the material in a given period of time established by the researcher in order to obtain data on a series of parametres such as: The relative abundance of the species, their constancy and dominance, the diversity of the population of carabids , the dynamics of the whole population in connection with the natural

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characteristics of the biotopes, comparisons among sites of collecting and the discussions of the results.

To collect the material from the clover crop ecosystem, we have chosen two sites: One site in the Rădăuți locality (Botoşani County) and the other site in the Ițcani locality (Suceava County) .

The surface of the site in the Rădăuți locality was 400 square metres and in the Ițcani locality 800 square metres**.**

The material was collected in the year 2005: June, July and August.

For the collection of the individuals of carabids , six pitfalls were used in each site,having a scientific justification (Stein, 1965) and one of economic order. (time, money). It is more advantageous to increase the number of samples, because the number of species and the number of individuals captured increases with the number of samples.

The soil pitfalls had a volume of 800 cubic centimetres, 7 centimetres in diameter and 11 centimetres in height,being protected from rainfalls.

The pitfalls were placed in the clover crop ecosystem at the beginning of the month of June (2005) in both sites, on two rows with three pitfalls on each row.The distance among rows and pitfalls was of three metres.

The pitfalls functioned in the ecosystem a number of 90 days (2005) (June,July and August).

As preserving liquid we prefered a solution of 3-4 % formol.

THE COLLECTION OF THE MATERIAL

In the temperate area, the climate influences the activity of ectothermic invertebrates. To follow the seasonal variation of the specific composition, the variation of diversity, and the number of individuals belonging to each species, the characteristic of the dynamics, we have collected the material twice a month.

The first collection was carried out at the middle of each month , and the second one at the end of each month. The material was collected from each pitfall, recording the main data (site, number of the pitfall, date of collection). For each site, six collections were made, that is 36 samples.

The scientific determination of the material

The identifyinng of the species, their nomenclature, and the classification of the Carabidae family into subfamilies were done according to FREUDE, HARDE, LOHSE, 1974

The aim and the objectives of the paper

Moldavia, by its geographical position within Romania and its pedo-climatic characteristics, is a zoogeographical region of Romania. The aim at collecting the material was to give the answeres at a number of objectives at the level of the Carabidae family in the ecological context of Moldavia and in the concrete conditions of the clover crop ecosystem, that is :

The taxonomic diversity of the Carabidae family in the year 2005, in those two sites (Suceava and Botoşani Counties) (Subfamilies, genera, species, the index of diversity, the evenness) compared to those obtained in 1977, 1978 from Suceava locality.

The knowledge of the concrete values of the relative abundance of species in those two sites (Ițcani and Rădăuți) to notice if there are differences between these sites;

The knowledge of the concrete values of the taxonomic structures of classes and of some ecological parametres in the concrete conditions of the clover crop ecosystem (dominance, evenness)

The characterization of the coenoses of Carabidae in the clover crop ecosystem,relating to: seasons of reproduction, the preference for moisture and biotopes, the food regime, the geographical distribution.

To have a general view on the classes as concerns ecological requirements (reproduction, moisture and biotope preferences, food regime and geographical distribution of the species of ground beetles in the clover crop ecosystem from Counties of Suceava and Botoşani, we also used the data published in literature cited in paper . The table with these data was attentively checked up by Dr. SUSTEK ZBYSEK from the Academy of Sciences, Slovakia.

Results obtained

Tab. 1 - Subfamilies of Carabidae, the relative abundance and dominance of the species of Carabidae in the clover crop from the sites Ițcani and Rădăuți, 2005.

	Subfamilies	Ițcani				Rădăuți			
		Sp	%	Indiv.	%	Sp	%	Indiv.	%
1	Cicindelinae	1	6.25	6	3.75	1	4.17	9	2.96
2	Carabinae	-	-	-	-	1	4.17	36	11.84
3	Bembidiinae	-	-	-	-	1	4.17	2	0.66
4	Anisodactylinae	2	12.50	3	1.88	1	4.17	9	2.96

5	Harpalinae	**4**	**25.00**	**85**	**53.13**	**4**	**16.67**	**45**	**14.80**
6	Pterostichinae	**8**	**50**	**65**	**40.63**	**12**	**50.00**	**195**	**64.15**
7	Zabrinae	1	6.25	1	0.63	4	16.67	8	2.63
	Total	**16**	**100.0**	**160**	**100.0**	**2 4**	**304**	**304**	**100.0**

Tab. 2 - The relative abundance and the dominance of the species of Carabidae collected from those two sites, Iţcani and Rădăuţi, 2005

No.crt	Name of species	Iţcani,2005		Rădăuţi,2005		Total	
		No.ind.	%	No.ind.	%	No.ind.	%
1	Cicindela germanica (Linne)	6	3.75	9	2.96	15	3.23
2	Carabus violaceus (Linne)	-	-	36	11.84	36	7.76
3	Bembidion lampros (Herbst)	-	-	2	0.66	2	0.43
4	Anisodactylus signatus (Panzer)	2	1.25	9	2.96	11	2.37
5	Anisodactylus binotatus (Fabricius)	1	0.63	-	-	1	0.22
6	Pseudophonus rufipes (De Geer)	66	41.25	35	11.51	101	21.77
7	Harpalus aeneus(Fabricius)	14	8.75	7	2.30	21	4.53
8	H.distinguendus (Duftschmid)	4	2.50	1	0.33	5	1.08
9	H. calceatus (Duftschmid)	1	0.63	-	-	1	0.22
10	H. luteicornis (Duftschmid)	-	-	2	0.66	2	0.43
11	Poecilus cupreus (Linne)	42	26.25	117	38.49	159	34.27
12	Poecilus lepidus (Leske)	2	1.25	-	-	2	0.43
13	Poecilus sericeus (F. de Wald.)	2	1.25	-	-	2	0.43
14	Pterostichus melanarius (Illiger)	12	7.50	53	17.43	65	14.01
15	P. strenuus (Panzer)	-	-	1	0.33	1	0.22
16	P. vernalis (Panzer)	-	-	2	0.66	2	0.43
17	P. diligens (Sturm)	-	-	1	0.33	1	0.22
18	P.ovoideus (Sturm)	-	-	1	0.33	1	0.22
19	Calathus fuscipes (Goeze)	2	1.25	1	0.33	3	0.65
20	Dolichus halensis (Schaller)	3	1.88	3	0.99	6	1.29
21	Pristonichus terricola(Herbst)	1	0.63	-	-	1	0.22
22	Agonum versutum (Gyllenhal)	-	-	1	0.33	1	0.22
23	Agonum viduum (Panzer)	-	-	1	0.33	1	0.22
24	Platynus assimilis (Paykull)	-	-	4	1.32	4	0.86
25	Agonum (Idiochroma) dorsalis (Pontoppidan)	1	0.63	10	3.29	11	2.37
26	Amara communis (Panzer)	-	-	2	0.66	2	0.43
27	Amara convexior (Stephens)	-	-	2	0.66	2	0.43
28	Amara aenea (De Geer)	1	0.63	2	0.66	3	0.65
29	Amara bifrons (Gyllenhal)	-	-	2	0.66	2	0.43
	Total genera	**14**		**13**	100.0		100.0
	Total species	**16**		**24**			
	Total individuals	**160**	**100.0**	**304**		**464**	

Tab. 3 - The relative abundance of the species of Carabidae collected from the clover crop ecosystem in Suceava and Botoşani Counties

	Name of the species	Suceava		Iţcani	Rădăuţi	Total	%
		1977	1978	2005	2005		
1	Cicindela germanica (Linne)	-	9	6	9	24	0.26
2	Carabus violaceus (Linne)	61	20	-	36	117	1.29
3	C. granulatus (Linne)	2	6	-	-	8	0.09
4	C. scabriusculus (Olivier)	2	-	-	-	2	0.02
5	Loricera pilicornis (Fabricius)	-	8	-	-	8	0.09
6	Broscus cephalotes (Linne)	-	2	-	-	2	0.02
7	Bembidion lampros (Herbst.)	-	-	-	2	2	0.02
8	Anisodactylus signatus (Panzer)	11	15	2	9	37	0.41
9	A. binotatus (Fabricius)	6	4	1	-	11	0.12

10	A. poeciloides (Stephens)	-	2	-	-	2	0.02
11	Pseudophonus rufipes (De Geer)	354	243	66	35	698	7.70
12	P. griseus (Panzer)_	3	14	-	-	17	0.19
13	Harpalus aeneus (Fabricius)	9	4	14	7	34	0.38
14	H.distinguendus (Duftschmid)	3	2	4	1	10	0.11
15	H. calceatus (Duftschmidt)	-	2	1	-	3	0.03
16	H. latus (Linne)	2	-	-	-	2	0.02
17	H. rubripes (Duftschmid)	-	2	-	-	2	0.02
18	H. luteicornis (Duftschmid)	-	-	-	2	2	0.02
19	Poecilus cupreus (Linne)	461	1575	42	117	2195	24.22
20	P. lepidus (Leske)	-	-	2	-	2	0.02
21	P. sericeus (F. de Wald.)	-	-	2	-	2	0.02
22	Pterostichus nigrita (Paykull)	2	-	-	-	2	0.02
23	P. melanarius (Illiger)	1817	3918	12	53	5800	64.01
24	P. strenuus (Panzer)	-	-	-	1	1	0.01
25	P. vernalis (Panzer)	-	-	-	2	2	0.02
26	P. diligens (Sturm)	-	-	-	1	1	0.01
27	P.ovoideus (Sturm)	2	7	-	1	10	0.11
28	Calathus fuscipes (Goeze)	2	-	2	1	5	0.06
29	C. melanocephalus (Linne)	-	2	-	-	2	0.02
30	Dolichus halensis (Schaller)	-	3	3	3	9	0.10
31	Pristonichus terricola (Herbst)	-	-	1	-	1	0.01
32	Agonum sexpunctatum (Linne)	-	2	-	-	2	0.02
33	A. versutum (Gyllenhal)	-	-	-	1	1	0.01
34	A. viduum (Panzer)	-	-	-	1	1	0.01
35	Platynus assimilis (Paykull)	-	-	-	4	4	0.04
36	Agonum (Idiochroma) dorsalis (Pontoppidan)	-	-	1	10	11	0.12
37	Amara equestris (Duftschmid)	2	-	-	-	2	0.02
38	A. ovata (Fabricius)	-	2	-	-	2	0.02
39	A. similata (Gyllenhal)	-	12	-	-	12	0.13
40	A. familiaris (Duftschmid)	-	2	-	-	2	0.02
41	A. communis (Panzer)	-	-	-	2	2	0.02
42	A. convexior (Stephens)	-	-	-	2	2	0.02
43	A. aenea (De Geer)	-	-	1	2	3	0.03
44	A. bifrons (Gyllenhal)	-	-	-	2	2	0.02
45	Claenius vestitus (Paykull)	-	2	-	-	2	0.02
	Total species	**16**	**24**	**16**	**24**		
	Total individuals	**2739**	**5858**	**160**	**304**	**9061**	**99.94**
	% of total material collected	**30.23**	**64.65**	**1.77**	**3.36**		
	Shannon index	**1.48**	**1.28**	**2.58**	**2.95**		
	Evenness %	**37**	**24**	**64**	**64**		

Tab.4 - The percenatge representantion (%) of the total number of species and individuals belonging to the subfamilies Harpalinae and Pterostichinae in the collecting sites, Suceava and Botoşani Counties.

	Harpalinae		Pterostichinae	
	No.Sp.%	No.Ind.%	No.Sp.%	No.Ind.%
Suceava,1977	31.25	13.55	33.33	83.39
Suceava,1978	31.25	4.56	20.83	94.01
Iţcani,2005	25.00	53.13	50.00	40.63
Rădăuţi,2005	16.67	14.80	50.00	64.15

Tab. 5 - Main ecological characteristics of the species of Carabidae in the clover crop (Suceava, 1977.1978, Iţcani 2005, (Suceava County), Rădăuţi, 2005 (Botoşani County)

	Name of the species	1	2	3	4	5
1	Cicindela germanica	Sp	M	Ols	Z	Wp
2	Carabus violaceus	A	M-X	F	Z	Wp
3	C.granulatus	Sp	H-.M	Eu	Z	Pa
4	C.scabriusculus	Sp	M-X	St,Cr	Z	EstE.
5	Loricera pilicornis	Sp	H	Eu	Z	Hl
6	Broscus cephalotes	Sp	X	St,Cr	Z	E.
7	Bembidion lampros	Sp	M	F,Ols	Z	Pa
8	Anisodacttylus signatus	Sp	M	Ols	P	Pa
9	Anisodactylus binotatus	S	M	St	P	Wp
10	Anisodactylus poeciloides	Sp	M-X	Rip.ha.	P	Em
11	Pseudophonus rufipes	A	M-X	Ols	P	Wp
12	P. griseus	A	M	Cr	P	Pa
13	Harpalus aeneus	Sp	M-X	Cr	P	Pa
14	H. distinguendus	Sp +S	M	Ols	P	Pa
15	H. calceatus	A	M-X	St	P	Pa
16	H.latus	A	M	St	P	Pa
17	H.rubripes	A	X	F	P	Wp
18	H..luteicornis	Sp	M	Ols	P	E
19	Poecilus cupreus	Sp	M	Cr	Z	WP
20	P. lepidus	A	M-X	Cr	Z	Es
21	P. sericeus	Sp	M.	Ols	Z	Wp
22	Pterostichus nigrita	S	M	F	Z	Pa
23	Pt.melanarius	A	M	Eu	Z	Es
24	Pt.strenuus	Sp	M	Eu	Z	Es
25	Pt. vernalis	Sp	M	F	Z	Es
26	Pt. diligens	Sp	M	Rip	Z	Es
27	Pt. ovoideus	Sp	M	F	Z	Ec
28	Calathus fuscipes	A	M	Eu	P	Wp
29	C. melanocephalus	A+Sp	M	Eu	P	Pa
30	Dolichus halensis	A	M	Cr	P	Pa
31	Pristonichus terricola	A	M	Ga	Z	E
32	Agonum sexpunctatum	Sp	H-M	Eu	Z	Pa
33	A. versutum	Sp	H	Rip	Z	Es
34	Agonum viduum	Sp	H	Rip	Z	Pa
35	Anchomenus dorsalis	Sp	M	Ols	Z	Wp
36	Platynus assimilis	Sp	H-M	F	Z	Pa
37	Amara equestris	Sp	M	Cr	P	Wp
38	Amara ovata	Sp	M	F	P	Pa
39	Amara similata	Sp	M	F, Ols	P	Wp
40	Amara familiaris	Sp	M	Cr	Fit.	Wp
41	Amara communis	Sp	M	Ols	P	Pa
42	A. convexior	Sp	M	F	P	Es
43	Amara aenea	Sp	M	Cr	P	Pa
44	Amara bifrons	Sp	M-X	Ols	P	Wp
45	Claenius vestitus	Sp	H	Rip	Z	Wp

1 = Reproduction season; 2 = Humidity preference; 3 = Biotope preference; 4 = Food regime; 5 = Zoogeographical distribution

Legend: Sp = Spring; A = Autumn ; S = Summer ; Sp+ S= Spring – Summer, S= Summer; M = Mesophilous ; M-H = Mesohygrophilous ; M-X =Mesoxerophilous ; H = Hygrophilous; F = Forest ; St = Steppe ; Eu = Euritopic ; Ols = Open landscape; F,Ols = Forest,Open landscape,Rip= Riparious; Ga= Galleries; Rip-ha= Riparious-halophilous Zoophagous ; P = Pantophagous ; Fit.Phytophag; Wp = West-palearctic ; Pa = Palearctic ; Hl= Holarctic; E = European ; Em = Euromediterranian ; Ec = Eurocaucasian ; Es= Eurosiberian ; EstE = East- European;

Tab. 6 - The seasons of reproduction of the carabids in the clover crop ecosystem, Suceava and Botoşani Counties (1977,1978, 2005)

	A	B	C	D	E	F
No of species	30	11	1	1	2	45
% of total	66.68	24.44	2.22	2.22	4.44	100.00

Legend : A .Spring; B.Autumnal ; C .Spring- Summer, D. Autumn+Spring; E. Summer

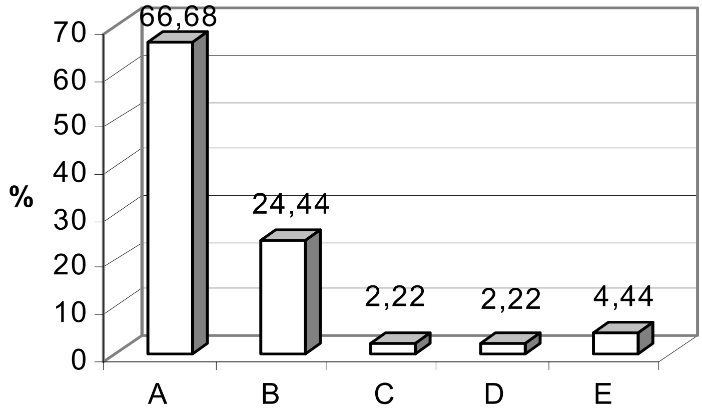


Fig. 1 - The percentage representation of reproduction seasons of the carabids in the clover crop ecosystems from Counties of Suceava and Botoţşani (Legend as in Table 6).

Tab. 7 - General moisture preferences of the species of carabids in the clover crop ecosystem, Counties of Suceava and Botoşani (1977,1978, 2005)

	A	B	C	D	E	F
No of species	4	3	28	8	2	45
% of total	8.89	6.67	62.22	17.78	4.44	100.00

Legend: A. Hygrophilous; B= Hygro-mesophilous; C=Mesophilous; D. Meso-Xerophilous;
E= Xerophilous, F=

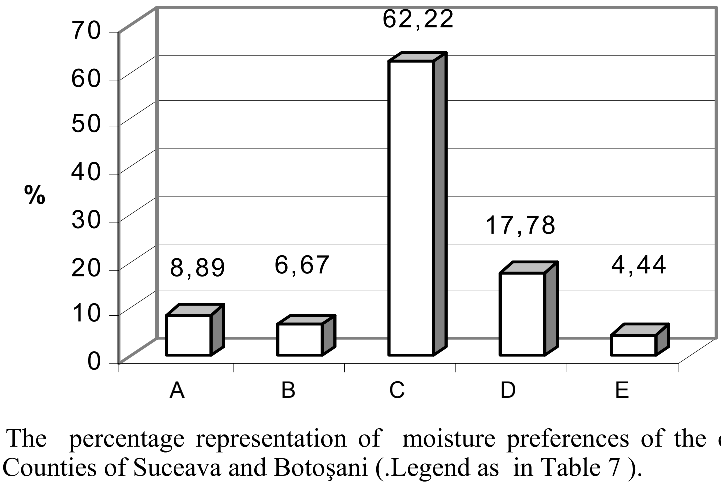
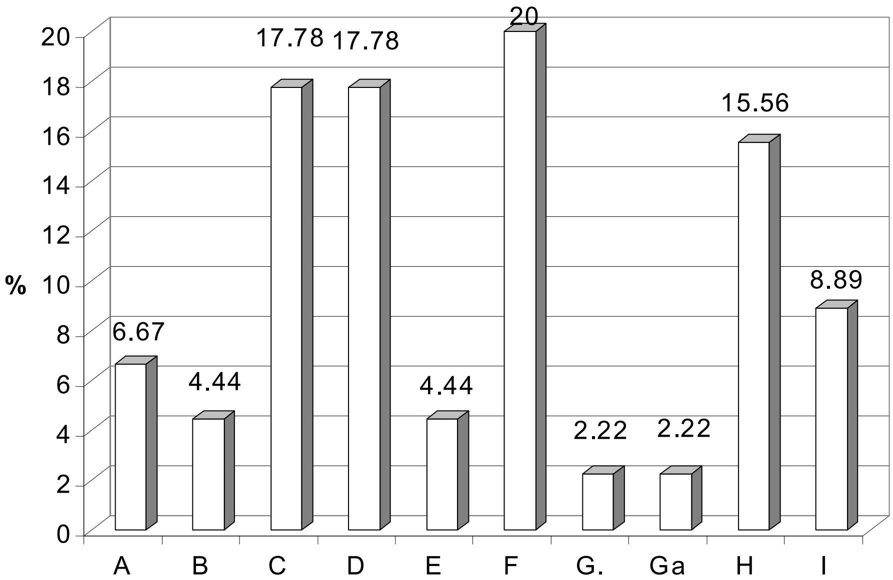


Fig. 2 - The percentage representation of moisture preferences of the carabids in the clover crop ecosystem from Counties of Suceava and Botoşani (.Legend as in Table 7).

Tab. 8 - General biotope preferences of the species of ground beetles in the clover crop ecosystem, Suceava and Botoşani Counties (1977,1978, 2005)

	A	B	C	D	E	F	G	Ga	H	I	J
No of species	3	2	8	8	2	9	1	1	7	4	45
% of total	6.67	4.44	17.78	17.78	4.44	20.00	2.22	2.22	15.56	8.89	100.00

Legend: A. Steppe; B .Steppe-Crops; C. Crops; D.Forest; E.Forest- Open landscape; F. Open land scape; G.Riparious-halophilous;Ga.Galleries; H.Eurytopic : I Riparious



Tab. 9 - General trophic regime of the species of carabids in the clover crop ecosystem, Counties of Suceava and Botoşani (1977,1978, 2005)

	A	B	C	D
No of species	23	21	1	45
% of total	51.11	46.67	2.22	100.00

Legend : A.= Zoophags; B.= Pantophags; C.= Phytophags

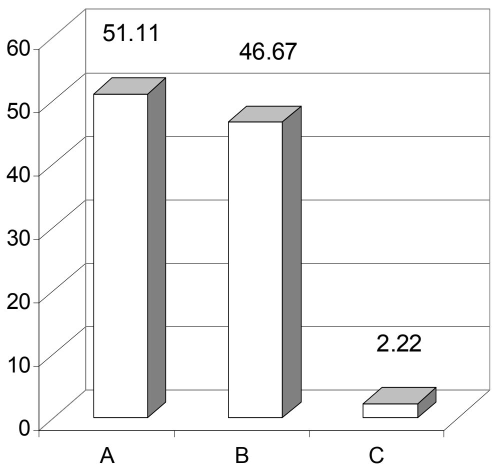


Fig. 4 – The percentage representation of general trophic regime of the species of carabids in the clover crop ecosystem from Counties of Suceava and Botoțșani (.Legend as in Table 9).

Tab. 10 - The general geographical distribution of the species of carabids in the clover crop ecosystem from Counties of Suceava and Botoşani

	A	B	C	D	E	F	G	H	I
No of species	14	17	1	3	1	7	1	1	45
%	31.11	37.78	2.22	6.67	2.22	15.56	2.22	2.22	100.00

Legend : A.= Palearctic; B. = West Palearctic ; C= .Holarctic D.= European; E= .Euromediterranian; F.= Eurosibirian; G.= Eurocaucasian; H = East-European

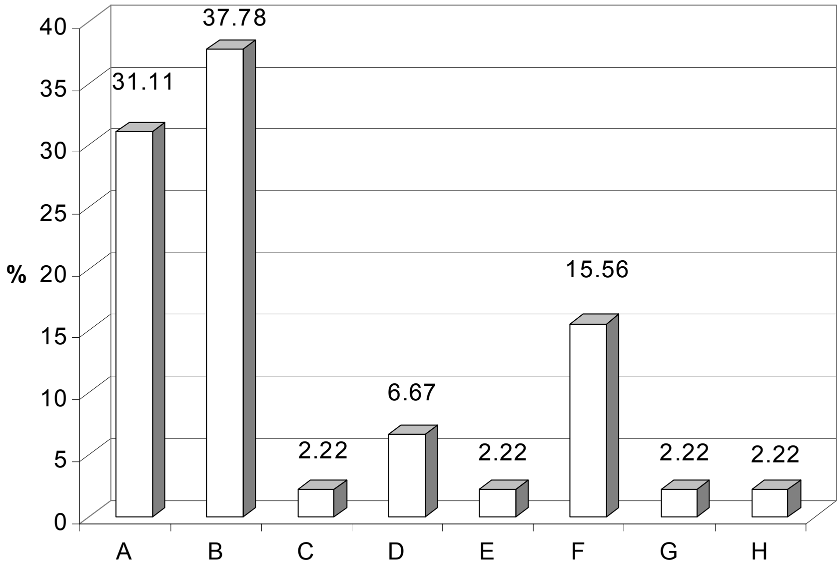


Fig. 5 - The Percentage representation of the general geographical distribution of the species of carabids in the clover crop ecosystem Suceava and Botoşani Counties (.Legend as in Table 10).

Discussions

Nature is in a permanent movement. "The living things in an environment are so intimately linked up with their surroundings that they form part of the environment itself" (2) The variation of ecological phenomena within certain limits is a general feature in any ecosystem.

The coenosis of Carabidae in the clover crop ecosystem is mainly formed of species and individuals belonging to the subfamilies *Harpalinae and Pterostichinae* (Table no 1, 4)

The degree of similitude, according to Sörensen's Coefficient, between the sites of collecting was 55 % (Suceava, 1977 and 1978), 50 % betwenn Iţcani and the two sites of Suceava, and 45 % between Rădăuţi (2005) and Iţcani (2005).

The scientific results of this paper show that the number of species, (alpha and gama diversity), the number of specimens , the Shannon diversity index ,the evenness present local variations as a result of the concrete ecological determinism.

Annual and local variations of the number of species (alfa diversity) was between 16 species and 24 species and the gama diversity had the value of 29 species (Iţcani and Rădăuţi) and 45 species (Suceava and Botoşani Counties). Nothing is isolated and without a cause in Nature and also in ecosystems. There is a close connection between ecodiversity and biodiversity, according to biocoenotic principles of THIENEMANN; The greater ecodiversity is , the greater the number of species is .

The percentages of the species in the subfamily *Harpalinae* ranges from 16.67 % (Rădăuţi, 2005) to 31.25) (Suceava, 1977, 1978) and of the individuals from 4.56 % (Suceava, 1978 to 53.13 % (Iţcani, 2005); while the percentages of the species in the subfamily *Pterostichinae* ranges from 20.83 % (Suceava,1978) to 50.00 % (Iţcani and Rădăuţi, 2005) and of the individuals from 40.63 % (Iţcani, 2005) to 94.01 % (Suceava, 1978). Clover is a mesophilous plant.

In the clover crop ecosystems from the north part of Moldavia, the species which are well represented, at the level of individuals:, that is, dominant or eudominant, are : *Pseudophonus rufipes. Poecilus cupreus* and *Pterostichus melanarius* (Table no. 3). One may explain this situation ecologically by two factors. Humidity of the soil and food for species. The clover (*Trifolium pratense*) is a mesophilous and perennial plant and owing to its ecological requirements is cultivated in more humid zones and with favourable pedoclimatic conditions.

The synthetic relations between the number of species and the number of individuals (total and for each species) are made evident by the Shannon index (Table no. 3).

Normally, the values of this index varies between 1.50 and 3.50. Our local results show that the Shannon index had values between 1.28 and 2.95, under the lower normal limits of variation. In the locality Suceava (1977), the value was 1.48 (with 16 species and 2739 individuals) and in the following year, 24 species species with 5858 individuals, The small value was caused by the low evenness: 37 % in 1977, and 28 % in 1978. The individuals of the two species *Poecilus cupreus and Pterostichus melanarius* represented 83.17 % of the total number of individuals in 1977, and 93.75 % in 1978.

As for reproduction seasons of the ground beetles in the clover crop ecosystem from the north part of Moldavia, we classified the species into five groups:*Spring, spring-summer, summer, autumnal and autumnal + spring*. Of the mentioned groups, two groups are dominant: The class of spring species (30 species, 66.68 %) and the class of autumnal species (11 species, 24.44 %) (Table no.6, Fig. No. 1). On the basis of research, observation in Nature, in laboratory, on the carabids (in total more than 20 years), NECULISEANU, (2003) in his sinthesis work with the title" The Carabids (Coleoptera, Carabidae in the Biogeographical Interference Zone of the Republic of Moldavia, (Taxonomy, Diversity, Zoogeography, Biology) and their Practical Importance", has drawn the conclusion that, within the perimetre of the Republic of Moldavia, there are two main groups as concerns the reproduction seasons: *Spring species* and *autumnal species*. This conclusion is supported by the results of our present paper and other published papers of ours (9,10,11,12). It is a general conclusion for the deciduous and coniferous ecosystems from Moldavia, clearings from deciduous forests, maize, potatoes of Moldavia that the spring species are dominant în variable proportion according to local conditions, followed by the autumnal species. The proportions of the reproductive classes in a coenosis of carabids is an ecological and evolutionary result connected with temperature, food, competition .

According to NECULISEANU (2003) the species with reproduction in spring- summer winter in the adult stage,their life cicle lasts one or two years.The laying of eggs occurs in the months of April –August, and the period of appearance of the larvae, pupae and the young adults coresponds to the months of May –September. (2003, pg. 134). The species with the reproduction in autumn and summer overwinter in the larval stage and partialy as adult; their life cicle lasts for one, two or three years.

Temperature and moisture are the main variable physical (ecological) factors of the environment influencing the activity and distribution of ground beetles in their biotope and habitats. We use here the term of habitat in the sense of a fragment of a biotope with similar conditions.

As for humidity, we classified the species into five groups. *Hygrophilous, Hygromesophilous,* M*esophilous, Meso-xerophilous and Xerophilous species*. The preference of the individuals of a species for a particular range of an environmental factor is according to their preferendum.The preferendum limits the distribution of individuals to biotope or habitat.Most individuals are found in the optimum preferendum of the species. Few individuals of the same species are found at the low and maximum condition of that factor,. as the curve of tolerance demonstrate us.

Of our results, 28 species (62.22 %) are *mesophylous*, 8 species (17.780 %) are *meso-xerophilous*. The other classes: *Hygrophilous, hygro-mesophilous* and *xerophilou*s species are represented with percentages under 9 % (Table no 7 , Fig. No 2). These results and other from our published papers support the conclusion that in the deciduous forests ecosystems and agricultural ecosystems from Moldavia, the majority of species are mesophilous in variable proportion according to the local conditions, followed by meso-xerophilous species.

As for prefered biotopes, according to our present results, we have classified the species into 10 classes. Species of steppe, steppe-crops, crops, forest, forest - open landscape, open land scape, riparious-halophilous, galleries, eurytopic, riparious. In the order of percentage, the open land scape species occupies a percentage of 20 % (9 species), followed by crops and forest species with the same percenatge of 17.78 % (8 species for each). After these classes, the group of eurytopic species follows, with 15.56 % (8 speces), The riparious species are represented by about 9 %. The other five classe have percentges under seven per cent (Table no 8, Fig. No 3). The open land scape species are species of intermediate size, belonging to the subfamilies *Cicindelina*e and especialy *Harpalinae* and *Zabrinae.* The forest species belong to *Pterostichinae* subfamiliy. The coenosis of Carabidae in the clover crop ecosystem is formed of a mixture of species which can find habitats to live and to survive.

As expected the food regime of the species of Carabids in the clover crop is predominantly zoophagous, that is 23 species (51.11 %) and pantophagous (21 species, 46.67 %) and only one species is phytophagous (Table no 9, Fig. no 4). Predation is primarily of insects on the soil surface. The predomination of the zoophagous species was also found in the forest ecosystems and agricultural ecosystems (9, 10, 11, 12).

As concerns the geographical distribution of the species of Carabids found in the clover crop from the north part of Moldavia, the results are shown in Table no 10 and Fig. no 5. The species were classified into 8 classes: Palearctic, West Palearctic, Holarctic,European, Euromediterranian, Eurosibirian, Eurocaucasian, East-European. Of these classes, three classes are dominant, in the order of percentages, they are: West Palearctic, Paleacrtic and Eurosibirian species. This statement is also valuable for the whole fauna of Carabidae in the Republic of Moldavia (NECULISEANU, 2003). In our results, the total percentage of these species is 84.45 %, a fact which is correlated with the meso and meso-xerophilous character of biotope;. 80 % of the species are mesophilous and meso-xerophilous species. The other five classes have percentages under six per cent (Table no 10, Fig. no. 5). So, from those above said, we can characterize the species occuring in the clover crop from the north of Moldavia as being mostly spring, mesophilous, open land scape, crop, forest, eurytopic, zoophagous, pantophagouis,West Palearctic, Palearctic, and Eurosibirian species.

Theoretically, the alpha and gama diversity of the epigeic fauna of ground beetles in the clover crop from north of Moldavia must be richer if other methods of collecting are applied, as for example hand collecting etc.

Conclusions

In the north part of Moldavia, the alpha diversity of the epigeic ground beetles in the clover crop ecosystem has ranged between 16 and 24 species, the Shannon index between 1.28 and 2.95 and the evenness between 24 % and 64 %.

The coenosis of Carabidae is maily formed of the species and individuals belonging to the subfamilies Harpalinae (species up to 25 % and individuals up to 53.13 %) and Pterostichinae, (species up to 50.00 % and individuals up to 94.01 % related to the soil humidity)

The dominant species are *Pseudophonus rufipes,*(DeGeer) *Poecilus cupreus* (Linne) *and Pterostichus melanarius* (Illiger), the last two species being mesophilous species correlated with the mesophilous character of the *Trifolium pratense*.

The coenosis of the species of Carabidae living in the clover crop ecosystem may be characterized as having species which reproduce mainly in spring and autumn,mainly mesophiloius, with general preference biotopes for open land scape, crops, forest, zoophagous and pantopphagous, distributed mainly, zoogeographically, in West Palearctic, Paleactic and EuroSiberian regions.

Rezumat

Lucrarea cuprinde diversitatea taxonomică epigee a subfamiliilor din familia Carabidae şi a speciilor aferente familiei Carabidae din ecosistemul culturii de trifoi din localităţile: Suceava (1977, 1978), Iţcani, 2005, (Judeţul Suceava), Rădăuţi, 2005 (Judeţul Botoşani).

Pentru colectarea materialului entomologic (Suceava) s-au folosit 12 capcane Barber cu lichid conservant şi protejate împotriva precipitaţiilor, iar pentru colectarea materialului din localităţile Iţcani şi Rădăuţi (2005) s-au folosit numai cîte 6 capcane în fiecare localitate, cu lichid conservant si protejate impotriva precipitaţiilor. Din fauna epigee s-au colectat specii şi indivizi aparţinând la un numar variabil de subfamilii de Carabidae , între 5 (Iţcani, 2005) şi 9 (Suceava, 1978). Subfamiliile care s-au găsit în toţi anii şi localităţile au fost: *Anisodactylinae, Harpalinae, Pterostichinae* şi *Zabrinae*. Dominante, din punct de vedere al speciilor şi indivizilor, sunt subfamiliile: *Harpalinae şi Pterostichinae*.

Alfa diversitatea speciilor de carabidae a variat între 16 specii, 2739 indivizi (30,23 % din total indivizi colectaţi în toţi anii), Suceava, 1977; Iţcani, 16 specii, 160 indivizi (1,77 %) şi 24 specii, 5858 indivizi, (64,65 %) Suceava, 1978); Rădăuţi, 2005, 24 specii, 304 indivizi (3,36 %).

Gama diversitate a speciilor de carabidae în cultura de trifoi în localităţile cercetate se ridică la 45 de specii

Valoarea indicelui Shannon a variat intre 1,28 (Suceava, 1978) si 2,95 (Rădăuţi, 2005), echitabilitatea a variat intre 28 % (Suceava, 1978) ;si 64 % (Iţcani şi Rădăuţi, 2005).

Coeficientul de asemănare Sörrensen între cenoza de carabidae din localitatea Suceava (1977, 1978) a fost de 55 % ; şi între localitatea Rădăauţi şi Iţcani a fost de 45 %; iar între Iţcani şi Suceava de 50 %.

Cenoza de carabide a ecosistemul culturii de trifoi în localităţile cercetate, în ce priveşte principalele cerinţe ecologice ale speciilor, se caracterizează prin următoarele: predomină speciile cu reproducere în primăvara, (66,68 %), cele cu reproducere în toamna (24,44 %), cele mezofile au un procent de 62,22 %, cu preferinţe pentru biotopii stepă -culturi (17,78 %,), culturi (17,78%),câmpuri deschise (20 %), euritopice (15,56 %), speciile zoofage şi pantofage (96,78%), distribuite preponderent geografic în Palearctic, şi vest Palearctic si regiunea Eurosiberiana, totalizând (84,45 %).

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References

1. FREUNDE COLL.,1974 - *Die Käfer Mitteleuropas, Band 2, Adephaga*, Goecke and Evers, Krefeld
2. MICHAEL PREMA, 1984 - *Ecological Methods for Field and Laboratory Investigations*, New Delhi.
3. NECULISEANU ZAHARIA, 2003- *Carabidele (Coleoptera, Carabidae) din zona de interferență biogeografică (Taxonomie, diversitate, zoogeografie, biologie şi importanță practică. Chişinău, manuscris*
4. VARVARA M., BRUDEA V., 1983- *Observations on the Structure of the Carabid Coenosis in the Clover Crop in Moldavia,* Lucrările celei de a III- a Conferințe de Entomologie, Iaşi, 20-22 mai, p.645-653.
5. VARVARA M., DONESCU D., DASCALU AL.,1999- *Coenological Observation on the Population of Carabidae (Insecta, Coleoptera) from Some Potato Crops in Moldavia*. An. St. Univ. Iaşi, Tpom.44-45, p.105-116.
6. VARVARA M., BRUDEA V., 1999- *The Structure ond Distribution of the Carabid Communities in the Maize Crops from Moldavia*. Univ. Bacău, Studii şi Com. St. p. 79- 84.
7. VARVARA M., 2001- *Observations on the Carabid Coenosis (Coleoptera, Carabidae) in the Potato Crops from Suceava District*. "Simpozionul Jubiliar Consacrat Aniversării a 30 de ani de la Formarea Rezervației Codrii", Vol. II, p.78-79, Chişinău.
8. VARVARA M., *Variation of the species diversity of Carabidae (Coleoptera, Carabidae) in two vegetal associations in the Bârnova forest, Iaşi* (East of Romania).
9. VARVARA M., 2005- *Diversity and the Main Ecological Requirements of the Epigeic Species of Carabidae (Coleoptera, Carabidae) from three Types of Agricultural Ecosytems in Suceava County*. Universitatea Bacău, Stud. si Cercet. St. Biologie, Seria nouă, 10, pg. 53- 61.
10. VARVARA M., 2005 - *Diversity and the Main Ecological Requirements of the Epigeic Species of Carabidae (Coleoptera, Carabidae) from two Types of Forest Ecosystems in Suceava County (Moldavia*) In press, Entomologica Romaniae.
11. VARVARA M., 2006- *The Taxonomic and Ecological Spectra of Carabids (Coleoptera, Carabidae) in the Clearing Ecosystem from the Deciduous Forests of Moldavia* Lucrările Simpozionului Entomofagii şi Rolul lor în Păstrarea Echilibrului Natural, An. St. Univ. Alexandru Ioan Cuza din Iasi, (Serie nouă), pg. 117- 129.
12. VARVARA M., 2006 - *The Taxonomic and Ecological Spectra of Carabids (Coleoptera, Carabidae) in three Agroecosystems from Moldavia*, Lucrările Simpozionului Entomofagii şi Rolul lor în Păstrarea Echilibrului Natural, An. St. Univ. Alexandru Ioan Cuza din Iasi, (Serie nouă), pg. 131- 146.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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DIVERSITY OF THE FAUNA OF SCARABAEOIDEA (INSECTA: COLEOPTERA) FROM THE „NORDUL GORJULUI" POTENTIAL NATURAL PARK, COUNTY GORJ, ROMANIA

CORNELIA CHIMIŞLIU*

ABSTRACT

CHIMIŞLIU C., 2006 - Diversity of the fauna of Scaraboidea (Insecta: Coleoptera) from the „Nordul Gorjului" potential natural park, county Gorj, Romania. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 268-273.

The paper contains the species of scarab beetles (Scarabaeoidea) from Oltenia, mentioned in the papers, published (1928 –2006) and there are added new data found by the author.

Key words:. diversity, scarabaeoidea, „Nordul Gorjului", Natural Park , Gorj, Romania

Introduction

In a previous paper, I mentioned the protected species of communitary interest recorded up to the year 2006 in the perimeter of the „Nordul Gorjului" Potential Natural Park (Chimişliu, 2006), this being one of the objectives of the study begun in the year 2005 under the co-ordination of Dr. ing. Cristian D. Stoiculescu, from I.C.A.S., Bucharest, for elaboration of the documentation in view to legalize the constitution of the " Nordul Gorjului " Natural Park. Another objective of the study is the knowledge of the insect fauna in this zone.

As within this study I have also elaborated the list of coleopterans from this perimeter for the first time, I think it is useful to introduce the results obtained in the informational circulation of speciality. In the present paper we present the list of coleopterans belonging to the Superfamily Scarabaeoidea. We mention the fact that the zone presents a big entomofaunistic diversity and was not sufficient enough studied up to present (2007). Thus, the first more ample data on the fauna of Scarabaeoidea from the carstic zone in the north of Oltenia (which also includes a part of the perimeter researched in the present paper), were mentioned in Marcu's papers (1928, 1929). Sporadic and sometimes indirect data from this zone are also found in the papers of Panin (1955, 1957), who ,in some species, mentions, the fact „distributed in the whole Romania", without other explanations. Starting from the year 1957, the entomafauna of Oltenia has been researched by the university staff from the Department of Entomology of the Faculty of Agricultural Sciences of the University of Craiova: Bobîrnac B, Matei Iulia, Costescu C., who published the scientific results in numerous entomofaunistic papers, in which there are also mentioned species of scarab beetles.

În the year 1999, Bobîrnac B. et al., elaborated two synthesis papers referring to the fauna of coleopterans from the Subcarpathian zone of Oltenia for the period 1928-1998 (Bobîrnac et al., 1999a) and to the fauna of scarab beetles from the Subcarpathian and mountain zones of Oltenia (Bobîrnac et al., 1999b), in which they synthesized the species previously published.

Starting from the year 1998, the scarab beetles from the Family Scarabaeidae (Panin, 1955, 1957) have been taken into study by the author of the present paper, who has brought up to date the stage of knowledge of this family of coleopterans in the fauna of Oltenia by consulting the bibliographical papers published by other authors and the adding of new data referring to the presence of these coleopterans in Oltenia,by scientific valorification of the data of the scarab beetles from the conserved entomological collections at the Section of Natural Sciences of the Museum of Oltenia, Craiova and of the „Porţilor de Fier" Museum, Drobeta Turnu Severin and partially, the entomological collection of the Faculty of the Faculty of Agronomical Sciences of the University in Craiova (Chimişliu, 2004a). Data

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about the species of Scarabaeoidea from the researched perimeter are in the papers published in the period 1999–2006, (Chimişliu 1999, 2000a-2000e, 2001a, 2001b, 2004a, 2004b, 2005a, 2005b, 2006a, 2006b). The present paper may constitute a bibliographical reference in the researches that will be made on this family of coleopterans.

Material and methods

The south limit of the"Nordul Gorjului" Potential Natural Park is on the line of the localities Baia de Fier, Novaci, Crasna, Bumbeşti Jiu, Runcu, Peştişani, Godineşti, Padeş, Cloşani.

The material of the present paper is represented by the species of Scarabaeoidea mentioned in the consulted bibliographical papers, published in the period of the years 1928-2006.The species recorded by Marcu (1928, 1929) were sum up from the author's papers, and the species mentioned by (Bobîrnac et al., 1999a, 1999b), I compared them with the data in the papers previously published by authors, adding the species omited in those two papers of synthesis, mentioned above.

Nomenclature and the taxonomy of species and the families identified were brought up to date in accordance with the taxonomic system and nomenclature used in the Fauna of Europea (www.faunaeur.org). In the species whose name was changed, there was also mentioned the old name.

Results obtained

There were identified 81 species and subspecies, belonging to 8 families of those 15 that are found in Romania's fauna, in accordance with the taxonomic system of the Fauna of Europaea. The best represented is the Family Aphodiidae (20 species), followed by the families : Scarabaeidae, Cetoniidae with 13 species each, Melolonthidae (12 species), Rutelidae (11 species), Geotrupidae (7 species), Lucanidae (3 species) and i Dynastidae (2 species) (Table 1)

Tab. 1

The taxonomic, numerical distribution of the species identified in the perimeter of the „Nordul Gorjului" Potential Natural Park

NO.	FAMILY	SUBFAMIY	TRIBE	GENERA	SPECIES
1.	**APHODIIDAE**	**Aphodiinae**	**-**	**15**	**20**
		Psammodiinae	**-**	**-**	**-**
2.	**CETONIIDAE**	**Cetoniinae**	**Cetoniini**	**4**	**7**
		Trichiinae	**Osmodermatini**	**1**	**1**
			Trichiini	**2**	**4**
		Valginae		**1**	**1**
3.	**DYNASTIDAE**	**Dynastinae**	**Oryctini**	**1**	**1**
			Pentodontini	**1**	**1**
4.	**GEOTRUPIDAE**	**BOLBOCERATINAE**	**-**	**1**	**1**
		GEOTRUPINAE	**-**	**3**	**5**
		LETHRINAE	**-**	**1**	**1**
5.	**LUCANIDAE**	**-**	**-**	**3**	**3**
6.	**MELOLONTHIDAE**	**MELOLONTHINAE**	**Melolonthini**	**2**	**5**
			Rhizotrogini	**2**	**4**
		SERICINAE	**-**	**1**	**3**
7.	**RUTELIDAE**	**Hopliinae**	**-**	**1**	**2**
		Rutelinae	**Anisopliini**	**2**	**2**
			Anomalini	**4**	**7**
8.	**SCARABAEIDAE**	**SCARABAEINAE**	**Coprini**	**1**	**1**
			Oniticellini	**1**	**1**
			Onitini	**-**	**-**
			Onthophagini	**3**	**10**
			Scarabaeini	**1**	**1**
	8	14	**14**	**51**	**81**

In comparison with the common species, there were recorded rare and very rare species for the fauna of Romania from this perimeter: Gnorimus *nobilis* (Linnaeus 1758), *Protaetia (Eupotosia) affinis* (Andersch 1797), *Protaetia (Liocola) lugubris, Trichius sexualis* Bedel 1906, *Bolboceras armiger* (Scopoli 1772), *as well as two protected species of communitary interest.: Osmoderma eremita* (Scopoli 1763) şi *Lucanus cervus* Linnaeus 1758 (Chimişliu. 2006).

In what follows, we present the species identified conformably to the taxonomic and nomenclature system in the Fauna of Europaea:

Family Aphodiidae

1. *Acrossus depressus* (Kugelan 1792) = *Aphodius (Acrossus) depressus* (Kug. 1792) - Păpuşa (peak)

(Bobîrnac, 1999b, Chimişliu, 2000e), Rânca (Chimişliu, 2001a, 2004b).
2. *Acrossus luridus* (Fabricius 1775) = *Aphodius (Acrossus) luridus* (Fabr. 1775) – distributed in the whole country (Panin, 1957). Păpuşa (Bobîrnac et al., 1999a), Cheile Sohodol, Straja (Chimişliu, 2001a, 2004b).
3. *Acrossus rufipes* (Linnaeus 1758) = *Aphodius (Acrossus) rufipes* (L. 1758) – Rânca (Bobîrnac, 1999b, Chimişliu, 2001a, 2004b).
4. *Agolius abdominalis abdominalis* (Bonelli 1812) = *Aphodius (Agolius) mixtus* Villa 1833 – Parâng (Panin, 1957).
5. *Agrilinus rufus* Moller 1782 = *Aphodius (Bodilus) rufus* Moll. 1782 Straja (Chimişliu, 2001b, 2004b).
6. *Aphodius fimetarius* (Linnaeus 1758) = *Aphodius (Aphodius) fimentarius* L. 1758 – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), distrubuted in the whole Romania (Panin, 1957), Ch. Sohodol (Bobîrnac et al., 1999a, 1999b), Ch. Sohodol, Straja (Chimişliu, 2001a, 2004b).
7. *Aphodius foetens* (Fabricius 1787) = *Aphodius aestivalis* Steph. 1839–Straja (Chimişliu, 2001b, 2004b).
8. *Bodilus ictericus* Laicharting 1781) = *Aphodius (Bodilus) nitidulus* Fabr. 1792 - Novaci (Chimişliu, 2000a, 2004b).
9. *Bodilus lugens* (Creutzer 1799) = *Aphodius (Bodilus) lugens* Creutz. 1799 – Straja (Chimişliu, 2001b, 2004b).
10. *Chilothorax distinctus* (O. F. Müller 1776) = *Aphodius (Volinus) distinctus* Müll. 1776) – distributed in the whole Romania (Panin, 1957), Poalele Păpuşii – (Bobîrnac, 1962) Parâng (Chimişliu, 2001a).
11. *Colobopterus erraticus* (Linnaeus 1758) = *Aphodius* (*Colobopterus) erraticus* L. 1758 – Straja (Chimişliu, 2001a, 2004b).
12. *Esymus pusillus* (Herbst 1789) = *Aphodius* (*Orodalus*) *pusillus* Hbst. 1789 – distributed in the whole Romania (Panin, 1957), Pietrele-Albe (Chimişliu, 2001b, 2004b).
13. *Euheptaulacus carinatus carinatus* (Germar 1824) = *Heptaulacus carinatus* Drap. 1819 – Oslea (Marcu, 1928, Bobîrnac et al., 1999a)
14. *Euorodalus coenosus Panzer 1789 = Aphodius* (*Orodalus*) *tristis* Zenk. 1801 - Pietrele-Albe (Chimişliu, 2001b, 2004b).
15. *Melinopterus prodromus* (Brahm 1790) = *Aphodius (Melinopterus) prodromus* Brahm. 1790 – distributed in the whole Romania (Panin, 1957), Straja (Chimişliu, 2001b, 2004b).
16. *Nialus varians* (Duftschmid 1805) = *Aphodius (Nialus) varians* Duft. 1805 - Cloşani (Marcu, 1929, Bobîrnac et al., 1999a), Păpuşa (Bobîrnac, 1999b).
17. *Oromus alpinus* (Scopoli 1763) = *Aphodius (Oromus) alpinus* (Scop. 1763) – Parâng (Panin, 1957), Straja (Chimişliu, 2001a, 2004b).
18. *Otophorus haemorrhoidalis* (Linnaeus 1758) = *A. (Otophorus) haemorrhoidalis* L. 1758 - Piatra Cloşani (Marcu, 1928, Bobîrnac et al., 1999a).
19. *Teuchestes fossor* (Linnaeus 1758) = *Aphodius (Teuchestes) fossor* L. 1758 - Piatra Cloşani (Marcu, 1928, Bobîrnac et al., 1999a), Rânca (Chimişliu, 2000a, 2001a, 2004b).
20. *Volinus sticticus* (Panzer 1798) = *Aphodius (Chilothorax) sticticus* (Panz. 1798) – probably in the whole Romania (Panin, 1957), Pietrele-Albe (Chimişliu, 2001b, 2004b).

Family Cetoniidae

21. *Cetonia aurata aurata* (Linnaeus 1761) = *Cetonia aurata aurata* (L. 1761) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), distributed in the whole Romania (Panin, 1957), Tismana, Ch. Sohodol (Bobîrnac et al., 1999a, 1999b), Baia de Fier, Ch. Sohodol, Pietrele Albe, Tismana (Chimişliu, 1999, 2004b).
22. *Gnorimus nobilis* (Linnaeus 1758) - Piatra Cloşani (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol, Pietrele Albe (Bobîrnac et al., 1999a, 1999b), Ch. Sohodol, Lainici, Pietrele Albe (Chimişliu, 2002, 2004b).
23. *Osmoderma eremita* (Scopoli 1763) - Tismana (Bobîrnac et al., 1999b), Ch. Sohodol, Tismana (Chimişliu, 2002, 2004b).
24. *Oxythyrea funesta* (Poda 1761) - Piatra Cloşani (Marcu O., 1928, Bobîrnac et al., 1999a), distributed in the whole Romania (S.Panin, 1957), Ch. Sohodol (Bobîrnac et al., 1999b), Bumbeşti, Ch. Sohodol, Tismana (Chimişliu, 1999, 2004b).
25. *Protaetia (Cetonischema) aeruginosa aeruginosa* (Linnaeus 1767) = *Cetonischema speciossisima* (Scop. 1768) - Tismana (Marcu, 1928, Bobîrnac et al., 1999a), Pietrele Albe (Chimişliu, 1999, 2004b).
26. *Protaetia (Eupotosia) affinis* (Andersch 1797) = *Eupotosia affinis* (Andersch 1797) - Ch. Sohodol (Chimişliu, 1999, 2004b).
27. *Protaetia (Liocola) lugubris* (Herbst 1786) = *Liocola marmorata* (Fabr. 1792) - Ch. Sohodol (Chimişliu, 1999, 2004b).
28. *Protaetia (Netocia) cuprea obscura* (Andersch 1797) = *Potosia cuprea obscura (*Andersch 1797) – *Tismana* (Marcu, 1928, Bobîrnac et al., 1999a, Chimişliu, 2000a), distributed in the whole Romania (Panin, 1957), Bumbeşti, Cheile Sohodol, Pietrele Albe (Chimişliu, 1999, 2004b).
29. *Trichius fasciatus* (Linnaeus 1758) - Ch. Sohodol, Parâng, Tidvele-Rânca (Bobîrnac et al., 1999a, 1999b), Ch. Sohodol, Novaci, Parâng, Pietrele Albe (Chimişliu, 2002, 2004b).
30. *Trichius sexualis* Bedel 1906 - Ch. Sohodol (Chimişliu, 2002, 2004b).
31. *Trichius zonatus* Germar 1829 – Tismana (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol (Chimişliu, 2002, 2004b).
32. *Tropinota (Epicometis) hirta* (Poda 1761) = *Tropinota hirta* (Poda,17619) – Tismana (Marcu, 1928, Bobîrnac et al., 1999a, Chimişliu, 2000a), distributed in the whole Romania (Panin, 1957), Cheile Sohodol (Bobîrnac et al., 1999a, 1999b, Chimişliu, 1999, 2004b).
33. *Valgus hemipterus* (Linnaeus 1758) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), distributed in the whole Romania (Panin, 1957), Baia de Fier, Cloşani, Tismana (Bobîrnac et al., 1999b), Baia de Fier, Tismana (Chimişliu, 2000a, 2004b).

Family Dynastidae

34. Oryctes (Oryctes) nasicornis (Linnaeus 1758) *Oryctes nasicornis* L. 1758 – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), distributed in the whole Romania

(Panin, 1957), Păpuşa (Bobîrnac et al., 1999b), Tismana (Chimişliu, 2000a), Bumbeşti, Ch. Sohodol , Păpuşa (Chimişliu, 2004b, 2005a).
35. *Pentodon idiota idiota* Herbst 1789 – distributed in the whole Romania (Panin, 1957), Ch. Sohodol, Novaci (Bobîrnac et al., 1999a, 1999b), Ch. Sohodol, Novaci (Chimişliu, 2004b, 2005a).

Family Geotrupidae

36. *Anoplotrupes stercorosus* (Scriba 1791) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), Tismana, the whole Romania (Marcu, 1929), (Panin, 1955), Novaci, Păpuşa, Rânca, Tismana (Bobîrnac et al., 1999b), Rânca, Urdele-Parâng (Chimişliu, 2000a), Baia de Fier, Cheile Sohodolul, Munţii Vâlcan, Novaci, Parâng, Pietrele Albe, Rînca, Tismana (Chimişliu, 2000b, 2004b).
37. *Bolboceras armiger* (Scopoli 1772) = *Odontaeus armiger* (Scop. 1772) – Novaci (Chimişliu, 2000b, 2004b).
38. *Geotrupes (Geotrupes) mutator* (Marsham 1802) – the whole Romania (Panin, 1955), Rânca (Bobîrnac et al., 1999b, Chimişliu, 2000a), Ch. Sohodol, Rânca (Chimişliu, 2000b, 2004b).
39. *Geotrupes (Geotrupes) puncticollis* Malinowsky 1811 = *Geotrupes (Geotrupes) spiniger* (Marsh. 1802) – Tismana (Marcu, 1929, Bobîrnac et al., 1999a), the whole Romania (Panin, 1955), Ch. Sohodol (Chimişliu, 2000b, 2004b).
40. *Geotrupes (Geotrupes) stercorarius* (Linnaeus 1758) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), the whole Romania (Panin, 1955), Novaci, Păpuşa (Bobîrnac et al., 1999b), Novaci, Rânca (Chimişliu, 2000a), Ch. Sohodol, Novaci, Rânca (Chimişliu, 2000b, 2004b).
41. *Lethrus (Lethrus) apterus* (Laxmann 1770) – Cloşani (Marcu, 1928, Bobîrnac et al., 1999a).
42. *Trypocopris (Trypocopris) vernalis* (Linnaeus 1758) – Păpuşa (vârf) (Bobârnac et al., 1982), Rânca, Tismana (Bobîrnac et al., 1999b), Tismana (Chimişliu, 2000a), Ch. Sohodol, Păpuşa, Rânca (Chimişliu, 2000b, 2004b).

Family Lucanidae

43. *Dorcus parallelipipedus* **(**Linnaeus 1758) - everywhere (Marcu, Bobîrnac et al., 1999a), Ch. Sohodol, Novaci (Bobârnac et al., 1999a), Baia de Fier, Cheile Bistriţei, Cheile Galbenului, Novaci, Pietrele Albe, Rânca (Chimişliu, 2006).
44. Lucanus cervus Linnaeus 1758 **-** everywhere (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol, Novaci (Bobârnac et al., 1999a), Tismana, Bârseşti, Cheile, Bistriţei; Ch. Sohodol, Lainici, Pietrele Albe, Tismana (Chimişliu, 2006a).
45. *Sinodendron cylindricum* (Linnaeus 1758) - everywhere (Marcu, 1928, Bobîrnac et al., 1999a), Straja (Chimişliu, 2006b).

Family Melolonthidae

46. *Amphimallon (s.str.) altaicus* Mannerheim 1825. - Rânca (Bobîrnac et al., 1999a, 1999b).
47. *Amphimallon assimile* (Herbst 1790) = *Amphimallon (Amphimallon) assimile* (Hbst. 1790) - Pietrele Albe (Chimişliu, 2000c, 2004b).
48. *Amphimallon solstitiale solstitiale* (Linnaeus 1758) *Amphimallon (Amphimallon) solstitialis* (L. 1758) – the whole Romania, with the exception of Dobruja (Panin, 1955), Straja (Chimişliu, 2000c, 2004b).
49. *Anoxia (Protanoxia) orientalis* (Krynicky 1832) *Anoxia (Protanoxia) orientalis* Kryn. 1832 – the region of the Subcarpathian hills (Panin, 1955), Novaci, Rânca (Bobîrnac et al., 1999b), Novaci, Straja (Chimişliu, 2000c).
50. *Anoxia (Anoxia) pilosa* (Fabricius, 1792) - Oltenia (lunca Jiului) (Panin, 1955).
51. *Anoxia (Anoxia) villosa* (Fabricius 1781) - Novaci (Bobîrnac et al., 1999b, Chimişliu, 2004b).
52. *Holochelus (Miltotrogus) aequinoctialis* (Herbst 1790) = *Miltotrogus aequinoctialis* (Hbst. 1790) – distributed in the whole Romania (Panin, 1957), Bumbeşti (Chimişliu, 2000c, 2004b).
53. *Melolontha hippocastani* Fabricius 1801 = *Melolontha (Melolontha) hippocastani* Fabr. 1801 - Cloşani (Marcu, 1928, Bobîrnac et al., 1999a), Baia de Fier (Bobîrnac et al., 1999b, Chimişliu, 2000a, 2000c, 2004b).
54. Melolontha melolontha (Linnaeus 1758) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), in all the zones of Romania (Panin, 1955), Pietrele Albe (Chimişliu, 2000c, 2004b).
55. *Omaloplia (Omaloplia) erythroptera* Frivaldszky 1835 = *Homaloplia erythroptera* Friv. 1835 - Tismana (Chimişliu, 2000a, 2004b, 2004b).
56. *Omaloplia (Omaloplia) ruricola* (Fabricius 1775) = *Homaloplia ruricola* (Fabr. 1775) – Tismana, Cerbu (Bobîrnac et al., 1999a, 1999b).
57. *Omaloplia (Omaloplia) marginata* (Füessly 1775) - Novaci (Bobîrnac et al., 1999a, 1999b, Chimişliu, 2000e), Ch. Sohodol (Chimişliu, 2004b).

Family Rutelidae

58. *Anisoplia (Anisoplia) agricola* Poda 1761 – the whole Subcarpathian region (Panin, 1955), Novaci (Chimişliu, 2000d, 2004b).
59. *Anomala dubia* (Scopoli 1763) = *Anomala aenea* Geer 1774 – Tismana (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol, Tismana (Bobîrnac et al., 1999a, 1999b), Pietrele Albe (Chimişliu, 2000d, 2004b).
60. *Anomala errans* (Fabricius 1775) – Runcu, Tismana (Bobîrnac et al., 1999a).
61. *(Anomala) solida* Erichson 1847 – Runcu, Tismana (Bobîrnac., 1974), Pietrele Albe (Chimişliu, 2000d, 2004b).
62. *Anomala vitis (*Fabricius 1775) – Tismana (Marcu, 1928), Cloşani (Marcu, 1929, Bobîrnac et al., 1999a), Runcu, Tismana (Bobîrnac, 1974),Ch. Sohodol (Bobîrnac B. et al., 1999b, Chimişliu, 2000d, 2004b).
63. *Blitopertha lineata* Fabr. - Ch. Sohodol (Bobîrnac et al., 1999b).
64. *Chaetopteroplia segetum* (Herbst, 1783) – Tismana (Chimişliu, 2000d, 2004b).
65. *Hoplia argentea* (Poda 1761) - Piatra Cloşani (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol (Bobîrnac et al., 1999a, 1999b), Pietrele Albe (Bobîrnac et al., 1999a, Chimişliu, 2004b).
66. *Hoplia praticola* Duftschmid 1805 – Tismana (Marcu, 1929, Bobîrnac et al., 1999a).

67. *Mimela aurata (*Fabricius 1801) – Tismana (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol (Bobîrnac et al., 1999a,1999b), Rânca, Ch. Sohodol (Chimişliu, 2000d, 2004b).

68. *Phyllopertha horticola (Linnaeus* 1758) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), Ch. Sohodol, Rânca (Bobîrnac et al., 1982, 1999a, 1999b), Ch. Sohodol, Novci, Pietrele Albe (Chimişliu, 2000d).

Family Scarabaeidae

69. *Caccobius schreberi* (Linnaeus 1767) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), Cerbu-Parâg (Bobîrnac et al., 1999b), (Chimişliu, 2004b).

70. *Copris lunaris* (Linnaeus 1758) – – everywhere (Marcu, 1928), Cloşani (Marcu, 1929, Bobîrnac et al., 1999a), Novaci (Bobîrnac et al., 1999b), Ch. Sohodol (Chimişliu, 2000b, 2004b).

71. *Euoniticellus fulvus* (Goeze 1777) – Novaci (Bobîrnac et al., 1999b), Ch. Sohodol, Novaci (Chimişliu, 2000b, 2004b).

72. *Euonthophagus amyntas* (Olivier 1789) = *Onthophagus (Onthophagus) amynthas* (Oliv. 1789) - Cloşani (Marcu, 1929, Bobîrnac et al., 1999a).

73. *Onthophagus (Palaeonthophagus) coenobita* (Herbst 1783) = *Onthophagus coenobita* Hbst. 1783 – the whole Romania (Panin, 1955).

74. *Onthophagus (Palaeonthophagus) fracticornis* (Preyssler 1790) = *Onthophagus fracticornis* Preyss. 1790 - pretutindeni (Marcu, 1928, Bobîrnac et al., 1999a), the whole Romania (Panin, 1955).

75. *Onthophagus (Furconthophagus) furcatus* (Fabricius 1781) *Onthophagus (Onthophagus) furcatus* (Fabr. 1781) - Tismana (Marcu, 1928, Bobîrnac et al., 1999a), the whole Romania (Panin, 1955), Novaci, Păpuşa - Parâng (Bobîrnac et al., 1999b, Chimişliu 2004b).

76. *Onthophagus (Palaeonthophagus) ovatus* (Linnaeus 1767) *Onthophagus (Onthophagus) ovatus* (L. 1767) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), the whole Romania (Panin, 1955), Novaci (Bobîrnac et al., 1999b, Chimişliu, 2000a), Tismana, Cloşani, Novaci (Chimişliu, 2000b, 2004b).

77. *Onthophagus (Onthophagus) taurus* (Schreber 1759) – everywhere (Marcu, 1928, Bobîrnac et al., 1999a), the whole Romania (Panin, 1955), Novaci (Bobîrnac et al., 1999b, Chimişliu Cornelia, 2000a), Ch. Sohodol, Pietrele Albe (Chimişliu, 2000b, 2004b).

78. *Onthophagus (Palaeonthophagus) vacca* (Linnaeus 1767) – the whole Romania (Panin, 1955), Novaci (Bobîrnac et al., 1999b, Chimişliu, 2000a, 2000b, 2004b).

79. *Onthophagus (Palaeonthophagus) verticicornis* (Laicharting 1781) - the whole Romania (Panin, 1955), Ch. Sohodol (Bobîrnac et al., 1999b), Ch. Sohodol, Pietrele Albe (Chimişliu, 2000b, 2004b).

80. *Onthophagus (Palaeonthophagus) vitulus* (Fabricius 1776) = *Onthophagus camelus* Fabr. 1787 - everywhere (Marcu, 1928, Bobîrnac et al., 1999a), Tismana, Cloşani (Chimişliu, 2000b, 2004b).

81. *Sisyphus schaefferi* (Linnaeus 1758) - Baia de Fier, Novaci (Bobîrnac B. et al., 1999b, Chimişliu Cornelia, 2000b, 2004b).

Discussions

Those 81 species identified in the published papers and consulted, represents nearly 50% of those 166 species belonging to the Superfamily Scarabaeoidea known up to present in the fauna of Oltenia (Chimisliu, 2004a, 2006).

În the period of the years 1957-1998 there were recorded 68 species , of which 36 were mentioned by Marcu (1928, 1929).

The majority of the species were found again in this perimeter by other authors . The species: *Hoplia praticola* Duftschmid 1805, *Euonthophagus amyntas* (Olivier 1789), *Onthophagus (Palaeonthophagus) fracticornis* (Preyssler 1790) and *Lethrus (Lethrus) apterus* (Laxmann 1770) have not been afterwards mentioned ,the same as the *Anoxia (Anoxia) pilosa* (Fabricius, 1792) and *Onthophagus (Palaeonthophagus) coenobita* (Herbst 1783), mentioned by Panin (1955, 1957).

The causes that the above mentioned species have not been found again may be the insufficient research of the zone, or the decrease of the individuals of the species, or even the possible disappearance of the species in the zone.

In the period of the years 1999-2006, the author of this paper has found 67 species, of which 54 species were found previously, and 13 species have been recorded new to the researched zone.

I consider that the number of species mentioned up to the year 2006, does not reflect the real situation in this teritory on the contrary, a study of this perimeter would increase not only the number of the identified species, but would also discover the species from other families of Scarabaeoidea .

Rezumat

Lucrarea sintetizează speciile scarabeiodee menționate în literatura de specialitate consultată, publicată în perioada anilor 1928-2006, din perimetrul potanțialului Parc Natural „Nordul Gorjului”.Au fost identificate 81 de specii din care 68 de specii semnalate în perioada anilor 1928-1998 de către Marcu (1928, 1929) şi Bobîrnac (1962, 1974) şi Bobîrnac et al. (1999a, 1999b). Majoritatea au fost regăsite în acest perimetru de alti autori. Speciile: *Hoplia praticola* Duft. 1805, *Euonthophagus amyntas* (Oliv. 1789), *Onthophagus (Palaeonthophagus) fracticornis* (Preyssl. 1790) şi *Lethrus (Lethrus) apterus* (Laxm. 1770) nu au mai fost menționate ulterior, la fel şi speciile *Anoxia (Anoxia) pilosa* (Fabr., 1792) şi *Onthophagus (Palaeonthophagus) coenobita* (Hbst 1783), menționate de Panin (1955, 1957). Cauzele necitarii ulterioare a speciilor menționate mai sus, sunt cercetarea insuficienta a zonei, sau micşorarea efectivului indivizilor speciilor sau chiar posibila dispariție a speciilor din zonă.

În perioada 1999-2006 au fost menționate 67 de specii de către Chimişliu (1999, 2000a-2000e, 2001a, 2001b, 2004a, 2004b, 2005a, 2005b, 2006a,

2006b), din care54 specii fost resemnalări, iar 13 specii au fost semnalări noi pentru zona abordată.

Sunt prezente şi specii rare şi foarte rare în fauna ţări, precum şi două *specii protejate de interes comunitar: Osmoderma eremita* (Scopoli 1763) şi *Lucanus cervus* Linnaeus 1758 (Chimişliu, 2006).

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References

1. BOBÎRNAC B., 1962 - Contribuţii la cunoaşterea entomofaunei. in: *Pajiştile din Masivul Parâng şi îmbunătăţirea lor.* Edit. Agro-silv. Inst. Agr. Craiova: 103 – 113.
2. BOBIRNAC B., *1974 - Cercetări asupra genului Anomala Sam. (Coleoptera) în Oltenia.* Stud. şi cerc. *Tg. Jiu: 207–217.*
3. BOBÎRNAC B., CHIMIŞLIU C., MITREA I. - 1999b. Asupra taxonomiei şi ecologiei familiei Scarabaeidae (Coleoptera-Insecta) din zonele colinară şi montană ale Olteniei. *Oltenia.* Stud. şi com. Şt. Nat. **XV,** Muz.Olteniei Craiova: 96-99.
4. CHIMIŞLIU C., 1999 - *Contribuţii la cunoaşterea subfamiliei Cetoniinae (Insecta: Coleoptera: Scarabaeidae) din Oltenia.* Bul. inf. Soc. lepid. rom. 10 (1-4). Cluj:145-151.
5. CHIMIŞLIU C. - 2000a. *Catalogul familiei Scarabaeidae (Coleoptera: Insecta) din Colecţia entomologică "I. Firu" conservată la Muzeul Olteniei Craiova.* Stud. şi com. Şt. Nat. **I,** Muz. Jud. Satu Mare: 468 – 476.
6. CHIMIŞLIU C., 2000b - *Contribuţii la cunoaşterea speciilor subfamiliilor Coprinae şi Geotrupinae (Insecta: Coleoptera: Scarabaeidae) din fauna de coleoptere a Olteniei.* Oltenia. Stud. şi com. Şt. nat. **XVI,** Muz. Olteniei Craiova: 133 - 140.
7. CHIMIŞLIU C., 2000c - *Specii din subfamilia Melolonthinae (Insecta: Coleoptera: Scarabaeidae) cunoscute în coleopterofauna Olteniei.* Oltenia. Stud. şi com. Şt. nat. **XVI,** Muz. Olteniei Craiova: 141 - 146.
8. CHIMIŞLIU C., 2000d - *Specii din subfamilia Rutelinae (Insecta: Coleoptera: Scarabaeidae) identificate în coleopterofauna Olteniei.* Analele Univ. Craiova V (XLI). Craiova: 30 - 35.
9. CHIMIŞLIU C., 2000e - *Specii din familia Scarabaeidae (Coleoptera-Insecta) semnalate în Coleopterofauna Olteniei până în anul 1999.* Stud. şi mat. "Marisia" XXVI, Muz. Jud. Mureş, Târgu-Mureş: 205-218.
10. CHIMIŞLIU C., 2001a - *Contribuţii la cunoaşterea speciilor subfamiliei Aphodiinae (Insecta: Coleoptera: Scarabaeidae) din entomofauna Olteniei.* Oltenia. Stud. şi com. Şt. nat. XVII, Muz. Olteniei Craiova.: 106 – 111.
11. CHIMIŞLIU C., 2001b - *Specii noi din genul Aphodius Illig. 1798 (Insecta: Coleoptera: Scarabaeidae: Aphodiinae) în fauna de coleoptere a Olteniei.* Oltenia Stud. şi com. Şt. Nat. XV, Muz. Olteniei Craiova: 112 – 114.
12. CHIMIŞLIU C., 2002 - *Contribuţii la cunoaşterea speciilor subfamiliei Trichiinae (Insecta: Coleoptera: Scarabaeidae) din fauna de coleoptere a Olteniei.* Argessis. Stud. şi com. Şt. Nat. ***IX,*** *Muz. Jud. Argeş, Piteşti: 239 – 245.*
13. CHIMIŞLIU C., 2004a - Conspectul speciilor suprafamiliei Scarabaeoidea (Insecta: Coleoptera) din fauna Olteniei. Oltenia. St. şi com. Şt. Nat. XX, Muz. Olteniei Craiova: 159 – 172
14. CHIMIŞLIU C., 2004b - *Cercetări taxonomice şi ecologice asupra familiei Scarabaeidae (Insecta: Coleoptera) în Oltenia.* Teză de doctorat Facultatea de Agronomie. Universitatea de Ştiinţe Agricole şi Medicină Veterinară, Bucureşti (România).
15. CHIMIŞLIU C., 2005a - Contribuţii la cunoaşterea subfamiliei Dynastinae (Coleoptera: Scarabaeoidea: Scarabaeidae) din fauna Olteniei. *Oltenia.* Stud. şi com. Şt. Nat, XXI, Muz. Olteniei Craiova: 121-126.
16. CHIMIŞLIU C., 2006a - Insecte protejate de interes comunitar din potenţialul Parc Natural Nordul Gorjului. *Oltenia.* Stud. şi com. Şt. Nat. XXII, Muz. Olteniei Craiova: 178-183
17. CHIMIŞLIU C., 2006b - Contribuţii la cunoaşterea lucanidelor (Coleoptera: Scarabaeoidea: Lucanidae) din entomofauna Olteniei. Analele Univ. „Al. I. Cuza", Iaşi. Seria Biologie: „in press".
18. MARCU O., 1928 - *Contribuţii la cunoaşterea coleopterelor Olteniei.* Arh. Olteniei, an VII. sept.- dec. nr. 39-40 : 473 - 487.
19. MARCU O., 1929 - *Contribuţii la cunoaşterea faunei Olteniei.* Arhivele Olteniei, an VIII, sept.- dec. nr. 45-46: 474 – 479.
20. PANIN, S., 1955 - *Fam. Scarabaeidae I.* Fauna R.P.R. **X**(3). Edit. Acad. Rom., Bucureşti.
21. PANIN, S., 1957 - *Fam. Scarabaeidae II***.** Fauna R.P.R. **X**(4). Edit. Acad. Rom., Bucureşti.
22. *** http//www.faunaeur.org (accesat în ianuarie 2007)

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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THE SINECOLOGICAL ANALYSE OF A FEW POPULATIONS OF CREPUSCULAR AND NOCTURNAL SCARAB BEETLES (INSECTA, COLEOPTERA, SCARABAEOIDAEA) FROM THE MEADOW OF SIRET RIVER AREA

MIHAELA ARINTON*

ABSTRACT

ARINTON M., 2006 - The sinecological analyse of a few populations of crepuscular and nocturnal scarab beetles (Insecta: Coleoptera: Scarabaeoidaea) from the meadow of Siret river area. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 274-279.

For studying the crepuscular and nocturnal scarabeoid fauna from the meadow of Siret River area, the author analyzed 323 scarab beetles. The insects were collected in 2004-2006, with the help of a lighting trap. Systematically speaking, the 323 specimens belong to 4 families, 6 subfamilies: Geotrupidae (Bolboceratinae, Geotrupinae), Ochodaeidae (Ochodaeinae), Trogidae, Scarabaeidae (Scarabaeinae, Aphodiinae, Melolonthinae), 14 genera and 19 species.

According to the sinecological analyze realized for the 19 species collected in this area, *Oxyomus sylvestris* Scop., *Melolontha melolontha* L. and *Aphodius (Acanthobodilus) immundus* Creutzer are the eudominant species; *Geotrupes spiniger* Marsh. is the only dominant species. For the studied area, *Oxyomus sylvestris* Scop., *Melolontha melolontha* L., *Aphodius (Acanthobodilus) immundus* Creutzer, *Geotrupes spiniger* Marsh. and *Pleurophorus caesus* Creutzer are the characteristic species. The other 14 species are accessories. Studying the cenotic affinities between the species, the results indicate that the highest affinity is between *Copris lunaris* L. and *Pleurophorus caesus* Creutzer – 96%. Other groups of species are represented by: *Ochodaeus chrysomeloides* Schrank – *Odontaeus armiger* Scop. (92%); *Aphodius (Acanthobodilus) immundus* Creutzer – *Geotrupes spiniger* Marsh. (89%); *Aphodius (Calamosternus) granarius* L. – *Aphodius (Bodilus) lugens* Creutzer (approximate 85%). Another group is represented by *Euheptaulacus sus* Herbst, *Aphodius (Nialus) varians* Duftsch. and *Polyphylla fullo* L. In this case, the value for the affinity indicator is 80%.

Key words: nocturnal, crepuscular scarabeoids, sinecological analyze

Introduction

Scarabs are heavy-bodied, oval beetles, which are included in a large suprafamily of insects – about 30,000 species distributed throughout most of the world. A large group of scarab beetles are scavengers, feeding on decaying vegetation or on the dung of grazing animals. Other species of scarab beetles feed on living plants. Members of these groups include such major crop and garden pests as the Japanese beetle, the rose chafer, and the May beetle. Adult plant-eating scarab beetles attack leaves, flowers, and fruits, while the larvae, which develop from eggs, laid in the ground, attack roots.

The scarabs are active in different periods of the year: some of them emerge from the soil early in the spring (*Rhizotrogus aequinoctiale* Herbst. – in March, *Rhizotrogus vernus* Germ. – in April, *Melolontha melolontha* L. – in May, *Amphimallon solstitiale* L., *Amphimallon caucasicus* Gyll., *Amphimallon assimile* Herbst – in June, *Monotropus nordmanni* Blanch., *Anoxia pilosa* F, *Anoxia villosa* F. – in June-July, *Anoxia orientalis* Kryn. and *Polyphylla fullo* L. are active in July-August). Also, some scarab beetles are active during the day, when the sun is shining, but many species are nocturnal or crepuscular. The insects included in first group can be collected during the day, directly from the flowers, or by using the entomological net. For studying the nocturnal or crepuscular scarabs it is necessary to use lighting traps.

Material and methods

The material analyzed in this paper work was collected with a lighting trap placed in the meadow of Siret River area (in Holt Village from Letea Veche Commune). The researches were made in 2004-2006.

In order to make a sinecological analyze, it was necessary to calculate some ecological indicators: abundance, frequency, constancy, dominance, ecological significance indicator (W) and similarity indicator.

Results and discussions

The nocturnal and crepuscular scarab fauna from this area has been represented by 323 scarab beetles, which, systematically belong to 4 families,

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6 subfamilies: Geotrupidae (Bolboceratinae, Geotrupinae), Ochodaeidae (Ochodaeinae), Trogidae, Scarabaeidae (Scarabaeinae, Aphodiinae, Melolonthinae), 14 genera and 19 species (table 1).

The results indicate that for the three years of study *Oxyomus sylvestris* Scop. was very well represented – 90 specimens (27.86%) and it is followed by *Melolontha melolontha* L. – 24.86%. Other well represented species are *Aphodius (Acanthobodilus) immundus* Creutz. (10.83%) and *Geotrupes spiniger* Marsh. (9.29%). These results are also graphically represented in figure 1. According to the same graphic, for 4 species the percentages distribution are less than 1%.

Tab. 1 - Distribution of species and individuals within the families and subfamilies of Scarabaeoidaea

No	Family	Subfamily	Specie	Total	
				A	**%**
1.	Geotrupidae	Bolboceratinae	*Odontaeus armiger* Scop.	6	1.86
2.		Geotrupinae	*Anoplotrupes stercorosus* Scriba	2	0.62
3.			*Geotrupes (Geotrupes) spiniger* Marsh.	30	9.29
4.	Ochodaeidae	Ochodaeinae	*Ochodaeus chrysomeloides* Schrank	7	2.17
5.	Trogidae		*Trox scaber* L.	5	1.55
6.	Scarabaeidae	Scarabaeinae	*Copris lunaris* L.	12	3.72
7.		Aphodiinae	*Aphodius (Acanthobodilus) immundus* Creutzer	35	10.83
8.			*Aphodius (Bodilus) lugens* Creutzer	4	1.24
9.			*Aphodius (Bodilus) punctipennis* Erich.	1	0.31
10.			*Aphodius (Calamosternus) granarius* L.	3	0.93
11.			*Aphodius (Chilothorax) distinctus* Müll.	1	0.31
12.			*Aphodius (Nialus) varians* Duftsch.	4	1.24
13.			*Euheptaulacus sus* Herbst	4	1.24
14.			*Oxyomus sylvestris* Scop.	90	27.86
15.			*Pleurophorus caesus* Creutzer	13	4.02
16.		Melolonthinae	*Maladera holosterica* Scop.	9	2.78
17.			*Melolontha melolontha* L.	79	24.46
18.			*Miltotrogus vernus* Germar	10	3.09
19.			*Polyphylla fullo* L.	8	2,48
	4	**6**	**15**	**323**	**100**

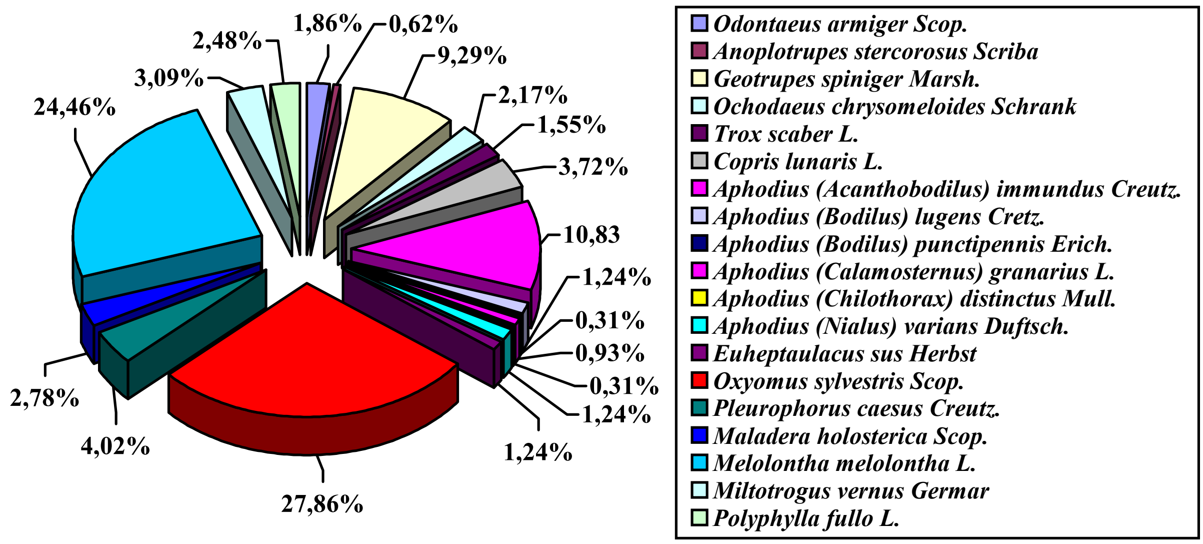

Fig. 1 - The percentages distribution of nocturnal and crepuscular scarab beetles from the meadow of Siret River area (2004-2006)

In table 2 is presented the sinecological analyze for all the species of crepuscular and nocturnal scarabs collected in the meadow of Siret River area. According to this analyze, 13 species are euconstant – they were collected in each year of study. The other species belong to constant – *Trox scaber* L., *Aphodius (Bodilus) lugens* Creutzer, *Aphodius (Calamosternus) granarius* L., *Anoplotrupes stercorosus* Scriba; and accessory species (*Aphodius (Chilothorax) distinctus* Müll., *Aphodius (Bodilus) punctipennis* Erich.).

Tab. 2 - Sinecological analyze of crepuscular and nocturnal scarabs collected in the meadow of Siret River area (2004-2006)

No	Specia	2004	2005	2006	A	C		D		W	
1.	*Oxyomus sylvestris* Scop.	35	28	27	90	100	C4	27,86	D5	27,86	W5
2.	*Melolontha melolontha* L.	21	17	41	79	100	C4	24,46	D5	24,46	W5
3.	*Aphodius immundus* Creutzer	15	8	12	35	100	C4	10,83	D5	10,83	W5
4.	*Geotrupes spiniger* Marsh.	13	9	8	30	100	C4	9,29	D4	9,29	W4
5.	*Pleurophorus caesus* Creutzer	2	5	6	13	100	C4	4,02	D3	4,02	W4
6.	*Copris lunaris* L.	2	5	5	12	100	C4	3,71	D3	3,71	W3
7.	*Miltotrogus vernus* Germar	2	5	3	10	100	C4	3,09	D3	3,09	W3
8.	*Maladera holosterica* Scop.	1	2	6	9	100	C4	2,78	D3	2,78	W3
9.	*Polyphylla fullo* L.	4	2	2	8	100	C4	2,48	D3	2,48	W3
10.	*Ochodaeus chrysomeloides* Schrank	2	2	3	7	100	C4	2,17	D3	2,17	W3
11.	*Odontaeus armiger* Scop.	2	1	3	6	100	C4	1,86	D2	1,86	W3
12.	*Aphodius varians* Duftsch.	1	1	2	4	100	C4	1,24	D2	1,24	W3
13.	*Euheptaulacus sus* Herbst	2	1	1	4	100	C4	1,24	D2	1,24	W3
14.	*Trox scaber* L.	-	1	4	5	66,66	C3	1,55	D2	1,03	W2
15.	*Aphodius lugens* Creutzer	-	3	1	4	66,66	C3	1,24	D2	0,82	W2
16.	*Aphodius granarius* L.	-	2	1	3	66,66	C3	0,93	D1	0,62	W2
17.	*Anoplotrupes stercorosus* Scriba	1		1	2	66,66	C3	0,62	D1	0,41	W2
18.	*Aphodius distinctus* Müll.	-	1	-	1	33,33	C2	0,31	D1	0,1	W2
19.	*Aphodius punctipennis* Erich.	1	-	-	1	33,33	C2	0,31	D1	0,1	W2
	15	**104**	**93**	**126**	**323**	**-**	**-**	**100**	**-**	**-**	**-**

Consulting the results presented in table 2, it was possible to identify the eudominant species: *Oxyomus sylvestris* Scop., *Melolontha melolontha* L., *Aphodius (Acanthobodilus) immundus* Creutzer. *Geotrupes (Geotrupes) spiniger* Marsh. is the single dominant specie. According to the same table, 6 species are subdominant, 5 subrecedent and 4 are recedent species.

Based on the values of ecological significance indicator (W), it was possible to identify the characteristic species. Thus, from the 19 species of scarabs identified for the meadow of Siret River area, 5 are characteristical (*Oxyomus sylvestris* Scop., *Melolontha melolontha* L., *Aphodius (Acanthobodilus) immundus* Creutzer. *Geotrupes (Geotrupes) spiniger* Marsh., *Pleurophorus caesus* Creutzer) and the other 14 are accessory species: *Copris lunaris* L., *Miltotrogus vernus* Germar, *Maladera holosterica* Scop., *Polyphylla fullo* L., *Ochodaeus chrysomeloides* Schrank, *Odontaeus armiger* Scop., *Aphodius (Nialus) varians* Duftsch., *Euheptaulacus sus* Herbst, *Trox scaber* L., *Aphodius (Bodilus) lugens* Creutzer, *Aphodius (Calamosternus) granarius* L., *Anoplotrupes stercorosus* Scriba, *Aphodius (Chilothorax) distinctus* Müll. and *Aphodius (Bodilus) punctipennis* Erich.

For studying the cenotic affinities between the species, it was necessary to calculate the similarity indicator – table 3. The dendrogram presented in figure 2 was realized based on the values of this indicator.

According to these data, the affinity between *Copris lunaris* L. and *Pleurophorus caesus* Creutzer is 96%. The affinity between these is not 100% because, although the two species were collected in each year of study, in 2004 they were represented by 2 specimens each, in 2005 – 3 individuals each, but for 2006, the difference between the two species is represented by a single specimen. Analyzing the same figure, it's easy to remark that the previous two species are correlated with *Miltotrogus vernus* Germar (91%).

The dendrograme also shows other groups of species: *Ochodaeus chrysomeloides* Schrank – *Odontaeus armiger* Scop. (92%); *Aphodius (Acanthobodilus) immundus* Creutzer – *Geotrupes spiniger* Marsh. (89%); *Aphodius (Calamosternus) granarius* L. – *Aphodius (Bodilus) lugens* Creutzer (aproximativ 85%). Another group is represented by *Euheptaulacus sus* Herbst, *Aphodius (Nialus) varians* Duftsch. and *Polyphylla fullo* L. In this case, the value for the affinity indicator is 80%.

These values can be explained by the fact that they were collected during each year of study and their abundance has similar values.

Conclusions

1. According to the study made in 2004-2006, the nocturnal and crepuscular scarab fauna from the meadow of Siret River area has been represented by 323 scarab beetles, which belong to 4 families, 6 subfamilies: Geotrupidae (Bolboceratinae, Geotrupinae), Ochodaeidae (Ochodaeinae), Trogidae, Scarabaeidae (Scarabaeinae, Aphodiinae, Melolonthinae), 14 genera and 19 species.
2. For the three years of study, *Oxyomus sylvestris* Scop. is very well represented – 90 specimens (27.86%) and it is followed by *Melolontha melolontha* L. – 24.86%.
3. According to the sinecological analyze, 13 species are euconstant. The other species are constant – *Trox scaber* L., *Aphodius (Bodilus) lugens* Creutzer, *Aphodius (Calamosternus) granarius* L., *Anoplotrupes stercorosus* Scriba; and accessory species (*Aphodius (Chilothorax) distinctus* Müll., *Aphodius (Bodilus) punctipennis* Erich.).
4. *Oxyomus sylvestris* Scop., *Melolontha melolontha* L., *Aphodius (Acanthobodilus) immundus* Creutzer are eudominant species. The results also indicate that *Geotrupes (Geotrupes) spiniger* Marsh. is the single dominant specie, 6 species are subdominant, 5 subrecedent and 4 are recedent species.
5. From the 19 species of scarabs identified for the meadow of Siret River area, 5 are characteristical (*Oxyomus sylvestris* Scop., *Melolontha melolontha* L., *Aphodius (Acanthobodilus) immundus* Creutzer. *Geotrupes (Geotrupes) spiniger* Marsh., *Pleurophorus caesus* Creutzer) and the other 14 are accessories species.
6. The affinity between *Copris lunaris* L. and *Pleurophorus caesus* Creutzer is 96%. Other groups of species are represented by: *Ochodaeus chrysomeloides* Schrank – *Odontaeus armiger* Scop. (92%); *Aphodius (Acanthobodilus) immundus* Creutzer – *Geotrupes spiniger* Marsh. (89%); *Aphodius (Calamosternus) granarius* L. – *Aphodius (Bodilus) lugens* Creutzer (aproximativ 85%). Another group is represented by *Euheptaulacus sus* Herbst, *Aphodius (Nialus) varians* Duftsch. and *Polyphylla fullo* L. In this case, the value for the affinity indicator is 80%.

Rezumat

Pentru studierea faunei de scarabeoidee crepusculare şi nocturne din zona de luncă a Siretului, am analizat 323 de scarabeoidee, care au fost colectate cu ajutorul unei capcane luminoase amplasate în satul Holt, comuna Letea Veche. Cercetările au fost realizate în perioada 2004-2006.

Din punct de vedere sistematic, cele 323 de insecte aparţin la 4 familii, 6 subfamilii: Geotrupidae (Bolboceratinae, Geotrupinae), Ochodaeidae (Ochodaeinae), Trogidae, Scarabaeidae (Scarabaeinae, Aphodiinae, Melolonthinae), 14 genuri şi 19 specii.

Conform analizei sinecologice realizate, din punct de vedere al dominanţei, *Oxyomus sylvestris* Scop., *Melolontha melolontha* L. şi *Aphodius (Acanthobodilus) immundus* Creutzer sunt eudominante, iar *Geotrupes spiniger* Marsh. este singura specie dominantă. Pentru zona cercetată am identificat 5 specii caracteristice: *Oxyomus sylvestris* Scop., *Melolontha melolontha* L., *Aphodius (Acanthobodilus) immundus* Creutzer, *Geotrupes spiniger* Marsh. şi *Pleurophorus caesus* Creutzer, celelalte 14 specii fiind accesorii. Studiind afinităţile cenotice dintre specii, am constatat că cea mai mare afinitate există între *Copris lunaris* L. şi *Pleurophorus caesus* Creutzer – 96%. Aceste 2 specii se relaţionează cu *Miltotrogus vernus* Germar, afinitatea fiind de 91%.

References

1. DELLACASA G., 1983 - *Monografie I Sistematica e nomenclatura degli Aphodiini italiani (Coleoptera: Aphodiinae)*. Museo Regionale di Scienze Naturali, Torino: 94-437 pag;
2. PANIN S. 1955 - *Fauna R.P.R. Coleoptera. Familia Scarabaeidae.* Vol. X, fasc. 3. Ed. Acad. R.P.R. Bucureşti: 37-50, 56-68;
3. PANIN S. 1957 - *Fauna R.P.R. Coleoptera. Familia Scarabaeidae.* Vol. X, fasc. 4. Ed. Acad. R.P.R. Bucureşti: 62-64, 99-113, 118-203, 217-221, 224-229, 235-238;
4. VARVARA M. et all. 1997 - *Aspects of knowledge of the fauna of Carabidae in the Dornelor Basin, Suceava County.* Anuarul Muzeului naţional al Bucovinei. Ştiinţele Naturii. vol. XIV. Suceava: 51-72;
5. VARVARA M. et all. 2001 - *Lucrări practice de ecologie – manual*. Ed. Univ. „Al. I. Cuza". Iaşi: 100-113.

Tab. 3 - The values of similarity indicator calculated for the nocturnal and crepuscular scarab species collected in the meadow of Siret River area (2004-2006)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1																		
2	76,92																	
3	56	61,40																
4	50	55,04	89,23															
5	25,24	28,26	54,16	60.46														
6	23,52	26,37	51,06	57.14	96													
7	20	22,47	44,44	50	86.95	90.91												
8	18,18	20,45	40,91	46.15	81.82	76.19	63.16											
9	16,32	18,39	37,21	42.10	57.14	60	66.66	58.82										
10	14,43	16,27	33,33	37.84	70	73.68	82.35	75	80									
11	12,5	14,11	29,27	33.33	63.16	66.66	75	66.66	71.43	92.31								
12	10,52	11,90	25	28.57	55.55	58.82	53.33	71.42	46.15	66.66	72.73							
13	8,51	9,63	20,51	23.53	47.06	50	57.14	46.15	50	54.54	40	44.44						
14	8,51	9,63	20,51	23.53	47.06	50	57.14	61.54	66.66	72.73	80	66.66	50					
15	8,51	9,63	20,12	23.53	47.06	50	57.14	46.15	66.66	72.73	80	44.44	50	75				
16	6,45	7,31	15,79	18.18	37.5	40	46.15	50	54.54	60	44.44	50	85.71	57.14	57.14			
17	4,34	4,93	10,81	12.5	26.66	28.57	33.33	36.36	40	44.44	50	28.57	33.33	66.66	66.66	40		
18	2,19	2.5	5,55	6.45	14.28	15.38	18.18	20	22.22	25	28.57	33.33	40	40	40	50	0	
19	2,19	2.5	5,55	6.45	14.28	15.38	18.18	20	22.22	25	28.57	0	0	40	40	0	66.66	0

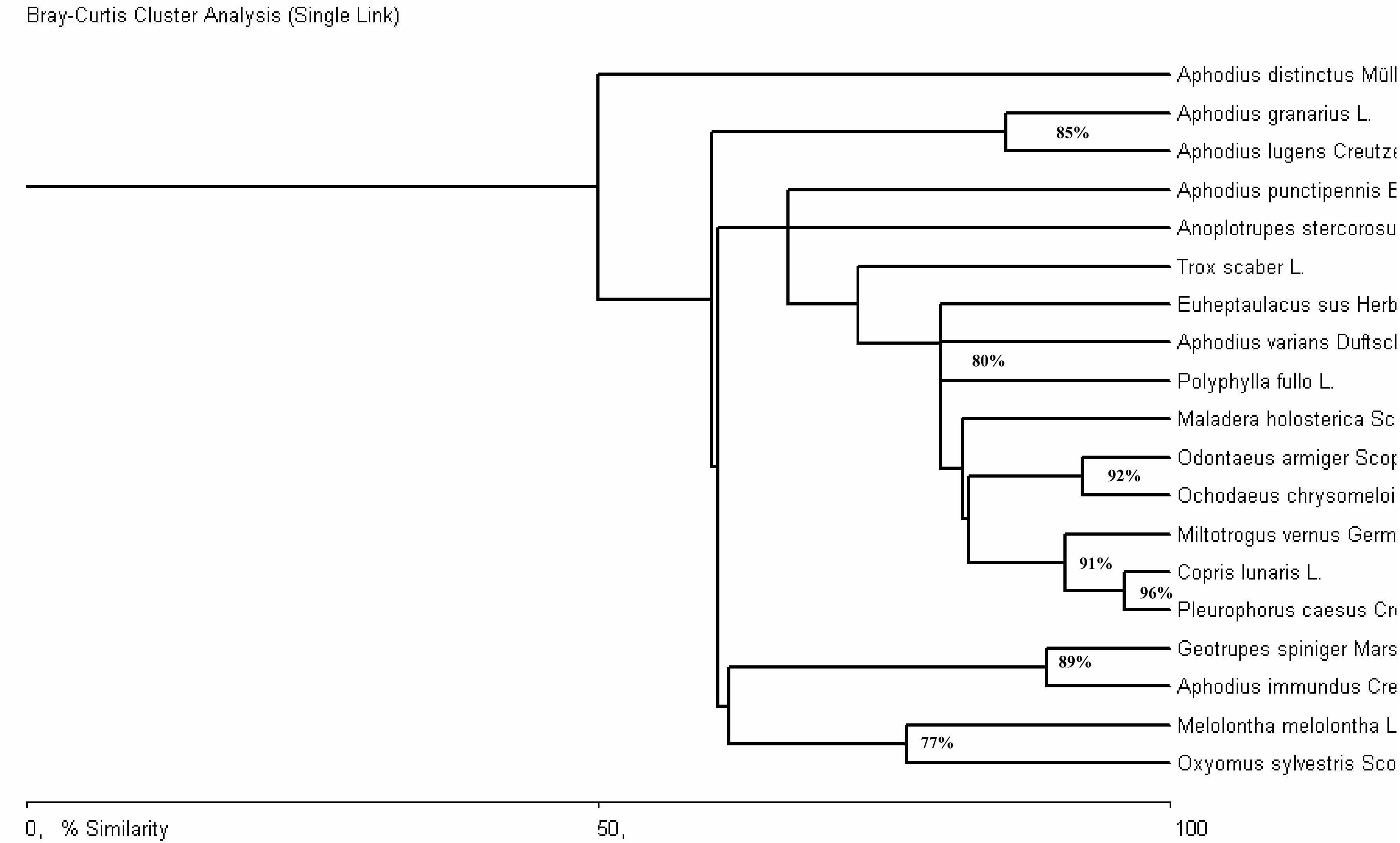

Fig. 2 - The cenotic affinities between the crepuscular and nocturnal scarab beetles collected in the meadow of Siret River (2004-2006)

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OBSERVATIONS CONCERNING SOME POPULATIONS OF *MELOLONTHA MELOLONTHA* L. (COLEOPTERA, SCARABAEOIDAEA) IN FOREST NURSERIES FROM BACAU AND NEAMT COUNTIES

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ABSTRACT

ARINTON M., CIORNEI C-TIN., 2006 - Observations concerning some populations of *Melolontha melolontha* L. (Coleoptera : Scarabaeoidaea) in forest nurseries from Bacau and Neamţ Counties. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 280-283.

The material analyzed in this paper was collected in August-September 2001 and August-September 2005, by making 150 soil soundings in 12 nurseries from Bacau and Neamt Counties. Using this method, in the two years of study, 164 L_3 transformed larvae and 24 adults were collected from the soil.

The investigated soils belonged to three types of texture: loamy-sandy soils, loamy soils and loamy-clayey soils. The highest density of *Melolontha melolontha* L. has been registered for loamy-clayey soils (3 L_3/m^2) and loamy soils (1.85 L_3/m^2).

Analyzing the loamy-sandy soils, the results denote that the largest number of larvae was collected from the clammy-wet soils – 7 L_3/m^2 and damp-moist soils – 5 L_3/m^2. In the loamy-sandy damp soils we have found only 0.35 L_3/m^2. For the loamy soils the largest number of larvae has been found into the dry-damp soils – 2.7 L_3/m^2 and into the moist ones – 2 L_3/m^2. The lowest density has been registered for the dry soils – only 0.25 L_3/m^2. Concerning the loamy-clayey soils, we have obtained the following results: 4 L_3/m^2 is the density of *Melolontha melolontha* L. for the dry soils, 3.5 L_3/m^2 for the damp-clammy soils and only 2 L_3/m^2 for the dry-damp ones

Key words: *Melolontha melolontha* L., larvae, density, soil

Introduction

Scarab beetles can be found in many different biotops. They feed on most types of dung and a wide range of plant and animal matter, from detritus through lower plants to virtually all higher plant tissues and carrion to predation on other insects. From all the development stages, only the adult is free, the other stages (the egg, the larva and the nymph) mostly live underground or under debris, so they are not exposed to sunlight. Therefore, the method used for collecting the adults depends on their habits: entomological net, pitfalls, lighting traps, etc. For finding larvae and nymphs it's necessary to dig into the soil – soil soundings.

Material and methods

This paper is based on the material of *Melolontha melolontha* L. larvae collected using soil soundings (pits of 1x1x1 m). The soil soundings were made in 12 nurseries from Bacau County (Filipea, Valea Rea – Livezi; Traian; Vermesti – Darmanesti; Tescani, Foale, Plaiul Baciului, Ghedeon – Moinesti) and Neamt County (Basta – Roman; Horaita – Garcina; Dumbrava – Tg. Neamt and Unguru – Borca). The researches were made in August-September 2001 and August-September 2005.

For each soil sounding we marked the number of larvae (separate by age), nymphs, adults and the type of the soil (texture and humidity degree).

The studies were made in August-September and therefore the larvae collected from the soil were in two stages of development: larvae of second (L_2) and third age (L_3). This is the reason why it was necessary for us to use the mathematics formula of transforming into third age larvae:

$$L_1 \frac{1}{5} + L_2 \frac{1}{3} + L_3$$

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For being able to analyze all the data obtained in the field, the results were presented as number of larvae (adults or nymphs) on m^2.

Results and discussions

For studding some populations of *Melolontha melolontha* L. from Bacau and Neamt Counties, we analyzed the material collected from the soil – 150 soil soundings were made in August-September 2001 and August-September 2005. Because the studies were made in those periods, we didn't find larvae of the first age, but we identified larvae of second and third age, nymphs and adults. All the adults found in this period of the year, are in fact imagos (their reproductive system is not completely developed), which display a positive geotropism.

The material collected in the two years (2001 and 2005) was represented by: 164 L_3 transformed larvae and 24 adults. The results are presented in table 1.

As it is known, the scarabs' larvae avoid the dryness, flooded fields and heavy soils. The presence of the May beetle in the ground also depends on the humidity degree of the soil. Studying the population of *Melolontha melolontha* L. in some forest nurseries from Bacau and Neamt Counties, it was necessary for us to allow for the characteristics of the investigated soils

Comparing all the data obtained in the field, we have noticed that the number of the larvae, nymphs and adults are influenced by the texture and the humidity degree of the soil. According to the table 1, the investigated soils belonged to three types of texture: loamy-sandy soils, loamy soils and loamy-clayey soils. The humidity degree has also differed. Thus, the substratum has been represented by clammy-wet soils, damp soils, damp-clammy soils, damp-moist soils, dry soils, dry-damp soils, moist soils.

Tab. 1 - The density of *Melolontha melolontha* L. specimens in the forest nurseries from Bacau and Neamt Counties

No	Nursery	2001					2005				
		Soil		S	L3/m^2	P (A) /m^2	Soil		S	L3 /m^2	P (A) /m^2
		T	H				T	H			
1	Traian (Bc)	l	dr	4	1	-	-	-	-	-	-
2		l	dm	2	1	-	-	-	-	-	-
3		lc	dm-cl	2	3.5	-	-	-	-	-	-
4		lc	dr-dm	2	2	-	-	-	-	-	-
5		lc	dr	1	4	-	-	-	-	-	-
6		ls	dm	2	1	-	-	-	-	-	-
7	Filipea (Livezi, Bc)	-	-	-	-	-	l	dr-dm	17	3	-
8	Valea Rea (Livezi, Bc)	-	-	-	-	-	l	dr-dm	3	1.33	-
9	Vermesti (Darmanesti, Bc)	-	-	-	-	-	l	dm	2	2.5	-
10	Tescani (Moinesti, Bc)	-	-	-	-	-	ls	dr-dm	1	2	-
11	Foale (Moinesti, Bc)	-	-	-	-	-	ls	dm	6		0.33
12	Plaiul Baciului (Moinesti, Bc)	-	-	-	-	-	ls	dm	2	2.5	1
13	Ghedeon (Moinesti, Bc)	-	-	-	-	-	ls	dm	10		0.1
14	Basta (Roman, Nt)	l	dm	3	1.33	-	ls	dm-cl	2	0.85	2
15		ls	dr-dm	2	1.5	-	l	dm	1	0.33	-
16		ls	dm	1	5	-	ls	dm	61	0.26	0.15
17	Horaita (Garcina, Nt)	l	dm	3	1	-	-	-	-	-	-
18		l	mo	1	2	-	-	-	-	-	-
19	Dumbrava (Tg. Neamt, Nt)	ls	dr-dm	7	1	-	l	dm-cl	9	0.56	0.78
20		ls	dm-mo	4	5	-	-	-	-	-	-
21	Unguru (Borca, Nt)	ls	cl-we	2	7	0.5	-	-	-	-	-

T – texture; H – humidity degree; S – the number of soil soundings; L_3 – larvae of the third age; P – pupae (nymphs); A – adults; l – loamy soil; lc – loamy-clayey soil; ls – loamy-sandy soil; cl-we – clammy-wet soil; dm – damp soil; dm-cl – damp-clammy soil; dm-mo – damp-moist soil; dr – dry soil; dr-dm – dry-damp soil; mo – moist soil

Tab. 2 - The presence of *Melolontha melolontha* L. specimens in different types of soil

No	Soil type	loamy-sandy soil				loamy soil				loamy-clayey soil				Total			
		S	N	L_3/m^2	A/m^2	S	N	L_3/m^2	A/m^2	S	N	L_3/m^2	A/m^2	S	N	L_3/m^2	A/m^2
1	dr	-	-	-	-	4	1	0.25	-	1	4	4	-	5	5	1	-
2	dr-dm	10	12	1.2	-	20	54	2.7	-	2	4	2	-	32	70	2.19	-
3	dm	84	29.56+16A	0.35	0.2	11	11.33	1.3	-	-	-	-	-	95	41+16A	0.43	0.17
4	dm-cl	-	-	-	-	9	5+7A	0.55	0.78	2	7	3.5	-	11	12+7A	1.1	0.64
5	dm-mo	4	20	5	-	-	-	-	-	-	-	-	-	4	20	5	-
6	mo	-	-	-	-	1	2	2	-	-	-	-	-	1	2	2	-
7	cl-we	2	14+1A	7	0.5	-	-	-	-	-	-	-	-	2	14+1A	7	0.5
Total		100	75.56+17A	0.76	0.17	45	73.33+7A	1.7	0.15	5	15	3	-	150	164+24A	1.1	0.16

S – the number of soil soundings; L_3 – larvae of the third age; N – nymphs; A – adults; cl-we – clammy-wet soil; dm – damp soil; dm-cl – damp-clammy soil; dm-mo – damp-moist soil; dr – dry soil; dr-dm – dry-damp soil; mo – moist soil

Analyzing the data presented in table 2, it is easy to notice that the highest density of *Melolontha melolontha* L. has been registered for loamy-clayey soils and loamy soils. Although, the loamy-sandy soils were the lightest investigated soils, the density of this species had a law value.

Comparing the density of *Melolontha melolontha* L. in the loamy-sandy soils, the results denote that the largest number of larvae was collected from the clammy-wet soils – 7 L_3/m^2 and damp-moist soils – 5 L_3/m^2. In the loamy-sandy damp soils we have found only 0.35 L_3/m^2 (fig. 1).

Regarding the loamy soils, the results indicate the largest number of larvae has been found into the dry-damp soils – 2.7 L_3/m^2 and into the moist ones – 2 L_3/m^2. The lowest density has been registered for the dry soils – only 0.25 L_3/m^2 (fig. 2).

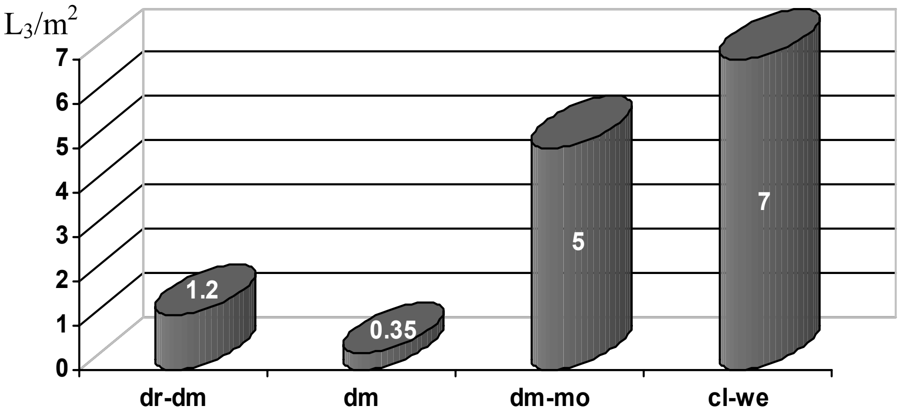

Fig. 1 The presence of L_3 transformed larvae into the loamy-sandy soils: dr-dm – dry-damp soil; dm – damp soil; dm-mo – damp-moist soil; cl-we – clammy-wet soil

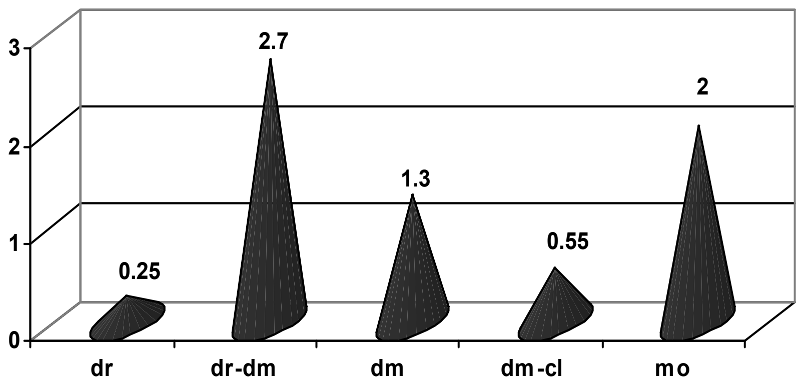

Fig. 2 - The presence of L_3 transformed larvae into the loamy soils: dr – dry soil; dr-dm – dry-damp soil; dm – damp soil; dm-cl – damp-clammy soil; mo – moist soil

Concerning the loamy-clayey soils, we have obtained the following results: 4 L_3/m^2 was the density of *Melolontha melolontha* L. in the dry soils, 3.5 L_3/m^2 in the damp-clammy soils and only 2 L_3/m^2 in the dry-damp ones – fig. 3.

In this work we were interested in studying some populations of *Melolontha melolontha* L. in correlation with two characteristics of the soil (texture and humidity), but they are not the only responsible factors for the presence and density of this species into the soil. The distribution of *Melolontha melolontha* L. is also influenced by many other factors such as: microclimatic and geographic conditions, treatments, exposure.

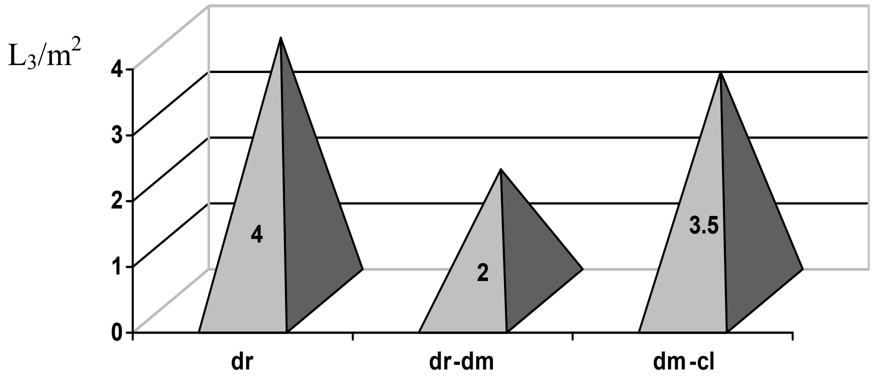

Fig. 3 -The presence of L_3 transformed larvae into the loamy-clayey soils: dr – dry soil; dr-dm – dry-damp soil; dm-cl – damp-clammy soil

Conclusions

1. The scarabs' larvae and nymphs live in the soil or under debris, so they are not exposed to sunlight. For studying some populations of *Melolontha melolontha* L. from Bacau and Neamt Counties, we analyzed the material obtained by making 150 soils soundings in 12 forest nurseries: Filipea, Valea Rea – Livezi; Traian; Vermesti – Darmanesti; Tescani, Foale, Plaiul Baciului, Ghedeon – Moinesti (Bacau), Basta – Roman; Horaita – Garcina; Dumbrava – Tg. Neamt and Unguru – Borca (Neamt). Those soundings were made in August-September 2001 and August-September 2005.
2. The material collected 2001 and 2005 totalized 164 L_3 transformed larvae and 24 adults. The texture of the soil where the soundings have been made differed: loamy-sandy soils, loamy soils and loamy-clayey soils. The results indicate that the highest density of *Melolontha melolontha* L. has been registered for loamy-clayey soils and loamy soils.
3. In the loamy-sandy soils, the largest number of larvae has been collected from the clammy-wet soils – 7 L_3/m^2 and damp-moist soils – 5 L_3/m^2.
4. Regarding the loamy soils, the largest number of larvae has been found into the dry-damp soils – 2.7 L_3/m^2 and into the moist ones – 2 L_3/m^2.
5. In the loamy-clayey soils, the density of *Melolontha melolontha* L. also varied: 4 L_3/m^2 for the dry soils, 3.5 L_3/m^2 for the damp-clammy soils and only 2 L_3/m^2 for the dry-damp ones.

Rezumat

Materialul analizat în această lucrare a fost colectat în perioadele august-septembrie 2001 şi august-septembrie 2005, prin metoda sondajelor de sol, care au fost realizate în 12 pepiniere din judeţele Bacău şi Neamţ. În total au fost efectuate 150 de sondaje în urma cărora au fost colectate 164 de larve L_3 (transformate) şi 24 de adulţi.

Sondajele au fost realizate în soluri cu texturi diferite: luto-nisipoase, lutoase şi luto-argiloase. Cele mai mari densităţi ale populaţiilor de *Melolontha melolontha* L. au fost înregistrate pentru solurile luto-argilose (3 L_3/m^2) şi lutoase (1,85 L_3/m^2). În cazul solurilor luto-nisipoase, cele mai multe larve au fost colectate din cele jilav-ude – 7 L_3/m^2 şi din cele reavăn-umede – 5 L_3/m^2. Pentru solurile lutoase, cele mai multe larve au fost colectate din cele uscat-reavăne (2,7 L_3/m^2). În ceea ce priveşte solurile luto-argiloase (cele mai grele soluri din cele analizate), am obţinut următoarele rezultate: pentru cele uscate densitatea a fost de 4 L_3/m^2, pentru cele reavăn-jilave 3,5 L_3/m^2, iar în cazul celor uscat-reavăne am găsit doar 2 L_3/m^2

References

1. BALACHOWSKY A. S., 1962 – *Traité d'entomologie*, tome I, Coleopteres, Masson et C-ie Éditeurs, Paris: 59-111;
2. NEŢOIU C-TIN, CHIMIŞLIU C., 2004 – *Rezultate preliminare privind infestarea cu diverse specii de scarabeide a suprafeţelor preluate din sectorul agricol în vederea împăduririi, din sudul Olteniei*. Muzeul Olteniei, Craiova. Oltenia. Studii şi comunicări, Ştiinţele Naturii, XX: 177-184;
3. PANIN S., 1955 - *Fauna R.P.R. Coleoptera. Familia Scarabaeidae, vol. X, fasc. 3*. Ed. Acad. R.P.R., Bucureşti.
4. SIMIONESCU A. et all, 2000 – *Protecţia pădurilor*. Regia Naţională a Pădurilor, Ed. Muşatinii, Suceava: 30-50;
5. VARVARA M. et all. 2001 – *Lucrări practice de ecologie*. Ed. Univ. „Al. I. Cuza", Iaşi: 86-99.

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LIST OF ELATERID SPECIES (COLEOPTERA: ELATERIDAE) FROM ROMANIA

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ABSTRACT

ZAHARIA G. L., 2006 - List of elaterid species (Coleoptera: Elateridae) from Romania. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 284-292.

Central and South-Estern European fauna of elaterids includes, so far, a number of 199 specied of click beetles out of which there were identified 142 species belonging to 58 genera and 7 families for Romanian fauna. Durind the undertaken studies were, also identified 6 new species for Romanian fauna. Most of Romanian elaterid species belong to the subfamilies Dendrometrinae (50) and Elaterinae (52), taxons with the widest spreading area in palerctic region.

Key words: list, species, Elateridae, Romania

Introduction

For the Central European fauna are quoted a number of 199 Elateridae species from 61 genera and 7 subfamilies. These species are spread in West Europe, Asiatic, meridional, but also endemic for this area. In Romania most o elaterid species are mentioned in faunistic lists made up for Coleoptera order (FUSS C. 1873; MONTANDON A. 1887, BIELZ A. 1887, DU BUYSSON 1887, JAQUET M. 1898-1902, HORMUZACHI C. 1901, FLECK E. 1906, PETRI K. 1911,1912), while fewer studies involved researches regarding the biology, ecology and control of pest species (ROGOJANU V. & col. 1962, RADU V. & GRECEA A. 1963,1965, 1967; PERJU T. & col. 1971, 1981, 1984; MĂRGĂRIT G. & col. 1990, 1992, 1995, 1996).

In this paperwork is used Crowson`s systematic (1981), revised by Stibick and Sánchez-Ruiz (1996).

Material and methods

To make out the elaterids species list from Romanian fauna were used as bibliographic material a number of 66 paperwork out of which 45 faunistic lists and 21 studies regarding only click beetles. I, also identified species from museums collections: Museum of Natural Science "Ion Borcea" Bacău (1457 specimens), Complex Museum of Natural Science Galaţi (504 specimens) and Natural Sciences Department of Oltenia Museum Craiova (459 specimens). Equally there were identified a number of 1326 specimens (859 adults and 467 larvae) collected through qualitative and quantitative methods of click beetles (sweeping with entomological net, soil polls, light trap, pheromone traps) from Moldavia and 321 specimens from National Park Piatra Craiului.

Results and discussions

The distribution of genera and species for the identified subfamilies is as following:

subfamily Pyrophorinae – 7 species belonging to the genera: *Agrypnus* Eschscholtz (1 species), *Lacon* Laporte (3 species), *Danosoma* Thomson (1 specie), *Aeoloderma* Latreille and *Drasterius* Eschscholtz (1 species);

subfamily Cardiophorinae – 13 species from the following genera: *Dicronychus* Brullé (5 species), *Cardiophorus* Eschscholtz (12 species) and from genus *Paracardiophorus* Schwarz - *Paracardiophorus musculus* Erichson, 1840 – new species for Romanian fauna;

subfamily Dendrometrinae – 50 species from 27 genera: *Cidnopus* Thomson (2 species), *Limonius* Eschscholtz (1 species), *Pheletes* Kiesenwetter (2 species); *Nothodes* LeConte (1 species); *Stenagostus* Thomson (1 species), *Hemicrepidius* Germar (2 species), *Crepidophorus* Mulsant et Guillebeau (1 species), *Athous* Eschscholtz (26 species) and *Diacanthous* Reitter (1 species), *Denticollis* Piller et

* "Ion Borcea" Natural Sciences Museum Complex

Mitterpacher (2 species), *Dima* Charpentier (1 species), *Anostirus* Thomson (5 species), *Actenicerus* Kiesenwetter (1 specie), *Ctenicera* Latreille (4 species), *Aplotarsus* Stephens (the species *Aplotarsus incanus* Gyllenhal – new for Romania); *Metanomus* Buysson (1 species), *Paraphotistus* Kishii (2 species), *Pristilophus* (2 species), *Neopristilophus* Buysson (1 species), *Selatosomus* Stephens (5 specii), *Calambus* Thomson (1 species), *Liotrichus* Kiesenwetter (1 species), *Eanus* LeConte (1 species), *Prosternon* Latreille (1 species), *Orithales* Kiesenwetter (1 species) and *Hypoganus* Kiesenwetter (1 species);

subfamily Elaterinae – 52 species included in 17 genera: *Ischnodes* Germar (1 species), *Megapenthes* Kiesenwetter (1 species), *Procaerus* Reitter (1 species), *Brachyogonus* Buysson (2 species), *Ectamenogonus* Buysson (1 species), *Ampedus* Germar (19 species), *Porthmidius* Germar (1 species), *Podeonius* Kiesenwetter (1 species), *Idolus* Desbrochers (1 species), *Betarmon* Kiesenwetter (1 species), *Elater* Linnaeus (1 species), *Sericus* Eschscholtz (2 species), *Dalopius* Eschscholtz (1 species), *Ectinus* Eschscholtz (1 species), *Agriotes* Eschscholtz (13 species), *Synaptus* Eschscholtz (1 species) and *Adrastus* Eschscholtz (6 species);

subfamily Hypnoidinae - 3 species from *Hypnoidus* Dillwyn genus;

subfamily Melatoninae - 7 species from *Melanotus* Eschscholtz genera;

subfamily Negastriinae -10 species from the following genera: *Fleutiauxellus* Méquignon (1 species) *Quasimus* Gozis (1 species), *Oedostethus* LeConte (1 species), *Negastrius* Thomson (2 species) şi *Zorochus* Thomson (4 species);

During the researches undertaken in the period 1999-2006 were identified 6 new species for Romanian fauna: *Ampedus cardinalis, Agriotes modestus, Cardiophorus asellus, Paracardiophorus musculus, Crepidophorus mutilatus* and *Athous jejunus*.

Ampedus cardinalis (Schiődte, 1865)

Species closely related to the presence of old oak forests, the larvae develops in rotten wood. Regarding the food died the larvae are predators and necrophagous, the pupations take place in August and the adult emerges in September and over winter under the bark or in trunk holes where they feed on xylophages insects. Geographical spreading: Europe, East of Siberia and Caucasus. This species was identified in Romania at LakeFurtuna (TL).

Agriotes modestus (Kiesenwetter, 1858)

Species spread at low altitude with larval development in the soil, the fight take place in June-Julie. Geographical spreading: Central and South of Europe, East of Asia and North of Africa. This species was identified in Romania at Agigea (CT)

Cardiophorus asellus (Erichson, 1840)

Species spread in wood land on strong xenophiles sandy soils. Geographical spreading: in Central and South Europe. This species was identified in Romania at Hanu Conachi (GL) and Creţeşti (VS).

Paracardiophorus musculus (Erichson, 1840)

This species is spread along water courses, prefers light soils with high moisture from hill and plane regions. Geographical spreading: Central and South Europe, North of Africa, Occidental Asia, Siberia, Japan. This species was identified in Romania at Hanu Conachi (GL) and Strehaia (MH).

Crepidophorus mutilatus (Rosenhauer, 1847)

This species is sprea in low mountain regions and larval development takes place in tree trunks, with no preference regarding the host species, rotten degree or moisture. Geographic spreading: Central and Northen Europe and Balkan region. This species was identified in Romania at Hemeiuşi (BC), Pufu – Slănicel (BC) and Valea Uzului (BC) .

Athous jejunus (Kiesenwetter, 1858)

Steppe species with larval development in soil. Geographical spread: Central and Soutern Europe. This species was identified in Romania at Suceava (SV), Calcaina (SV) and Stânca-Ştefăneşti (BT).

Conlusions

Out of the species mentioned fro Central South-Eastern Europe (199 species) were identified a number of 142 Elateridae species for Romania fauna which are included in 58 genera and 7 subfamilies. Most of the species belong to the subfamilies Dendrometrinae (50 species) and Elaterinae (52 species). Among the identified species were recorded 6 new species for Romanian fauna: *Ampedus cardinalis, Agriotes modestus, Cardiophorus asellus, Paracardiophorus musculus, Crepidophorus mutilatus* and *Athous jejunus*

References

1. BIELZ, A., 1887– *Siebenbürgens Käferfauna nach ihrer erforschung bis zum schlusse des Jahres 1886*, Hermanstadt: 5-80.
2. CIUCĂ L., CIORNEI C-TIN, 2002 – *Researches regarding the spreading of elaterid species in forest nurseries from oak region in Moldova*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Iaşi, Tom XLVIII: 55-61.
3. CIUCĂ L., CIORNEI C-TIN, 2003 – *Biodiversitatea speciilor de elateride (Coleoptera: Elateridae) din Parcul Dendrologic Hemeiuşi*, Lucrările celei de a 6-a Conferinţe Naţionale pentru Protecţia Mediului prin Mijloace Biologice şi Biotehnice şi a celei de a

3 - a Conferinţe Naţionale de Ecosanogeneză, Braşov: 254-261.
4. CIUCĂ L., MUSTAŢĂ GH., 2003 – *The biodiversity of click beetles (Coleoptera: Elateridae) from Moldavia*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Iaşi, Tom XLIX: 41-52.
5. CIUCĂ LĂCRĂMIOARA, 2003 – *The catalogue of click beetles species (Elateridae, Coleoptera) identified in Moldavia*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Iaşi, Tom XLIX: 95-109
6. CIUCĂ L., CIORNEI C-TIN, 2002 – *Researches regarding the spreading of elaterid species in forest nurseries from oak region in Moldova*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Iaşi, Tom XLVIII: 55-61.
7. CIUCĂ L., CIORNEI C-TIN, 2003 – *Biodiversitatea speciilor de elateride (Coleoptera: Elateridae) din Parcul Dendrologic Hemeiuşi*, Lucrările celei de a 6-a Conferinţe Naţionale pentru Protecţia Mediului prin Mijloace Biologice şi Biotehnice şi a celei de a 3 - a Conferinţe Naţionale de Ecosanogeneză, Braşov: 254-261.
8. CIUCĂ L., MUSTAŢĂ GH., 2003 – *The biodiversity of click beetles (Coleoptera: Elateridae) from Moldavia*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Iaşi, Tom XLIX: 41-52.
9. CIUCĂ L., 2003 – *The catalogue of click beetles species (Elateridae, Coleoptera) identified in Moldavia*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Iaşi, Tom XLIX: 95-109
10. HORMUZACHI, C., 1901 – *Cercetări noi asupra raporturilor faunistice din Bucovina, cu privire specială la clasa coleopterelor – partea I – Caracterul faunei şi vegetaţiei bucovinene. Împărţirea tării în regiuni naturale. Conclusiuni generale*; Buletinul Societăţii de Ştiinţe din Bucuresci, Imprimeria Statului, Bucresci, an X, no. 1-2: 81-95.
11. HORMUZACHI, C., 1901 – *Cercetări noi asupra raporturilor faunistice din Bucovina, cu privire specială la clasa coleopterelor – partea II – Enumerarea coleopterelor noui pentru fauna Bucovinei culese în anii 1893 până 1900*; Buletinul Societăţii de Ştiinţe din Bucuresci, an X, no. 1-2; Imprimeria Statului, Bucresci: 95-106.
12. IAMANDEI M., MANOLE, T. MĂRGĂRIT GR., 1999 – *Spectrul şi răspândirea speciilor din Coleoptera, Elateridae în România*, Analele Institutului de Cercetări pentru Protecţia Plantelor, Bucureşti ,vol. XXX: 89-99.
13. JAQUET M., 1898 – *Faune de la Roumanie, Insectes récoltés par Mr le Dr. M. Jaquet en 1897 et déterminés par Mr. E. Poncy, entomologiste à Genève*; Buletinul Societăţii de Ştiinţe, Bucureşti, 7/2,: 3-5.
14. JAQUET M., 1899 – *Faune de la Roumanie, Coléoptères récoltés par Mr le Dr. M. Jaquet et déterminés par Mr. E. Poncy à Genève*; Buletinul Societăţii de Ştiinţe, Bucureşti, 8/4-5: 370-377.
15. JAQUET M., 1900 – *Faune de la Roumanie, Coléoptères récoltés par Mr le Dr. M. Jaquet et déterminés par Mr. E. Poncy à Genève*; Buletinul Societăţii de Ştiinţe, Bucureşti, 9/4: 392-400.
16. JAQUET M., – 1901, *Faune de la Roumanie, Coléoptères récoltés en 1899 par Mr le Dr. M. Jaquet et déterminés par Mr. E. Poncy à Genève*; Buletinul Societăţii de Ştiinţe, Bucureşti, 10/5: 483-497.
17. JAQUET M., 1902 – *Faune de la Roumanie, Coléoptères récoltés par Mr le Dr. M. Jaquet et déterminés par Mr. E. Poncy à Genève*; Buletinul Societăţii de Ştiinţe, Bucureşti, 11/ 4: 449-457.
18. JAQUET M., 1903 – *Faune de la Roumanie, Coléoptères récoltés par Mr le Dr. M. Jaquet et déterminés par Mr. E. Poncy, entomologiste à Genève*; Buletinul Societăţii de Ştiinţe, Bucureşti, 12/ 1-2: 88-96.
19. MANOLE T., MĂRGĂRIT GR., BECHEZ M., HONDRU N., CHIRECEANU C-TINA, DĂNULESCU M., 1991 – *Spectrul speciilor de insecte din familia Elateridae şi răspândirea acestora în unele zone şi culturi agricole*, Analele ICPP, Ed. Tehnică Agricolă, Bucureşti, vol. XXVI,: 64-88.
20. MANOLE, T., MĂRGĂRIT, GR., DĂNULESCU M., 1996 – *Cercetări privind*

entomofauna dăunătoare şi utilă din culturile de graminee perene de pajişti din zona pedoclimatică Braşov II; Analele Institutului de Cercetări pentru Protecţia Plantelor, Ed. Conphys, Bucureşti, vol. XXVII: 157-165.

21. MANOLE TR., 1990 – *Spectrul şi structura elateridelor (Coleptera) din zona Lugoj, judeţul Timiş*, Buletinul Informativ al Academiei de Ştiinţe Agricole şi Silvice, Bucureşti, nr. XIX: 217-223.
22. MĂRGĂRIT GR., HONDRU N., TROTUŞ E., SITITEANU C., 1998 – *Cercetări asupra structurii şi abundenţei viermilor sârmă (Coleoptera, Elateridae) în diferite culturi agricole din zona Secuieni – Neamţ*, Probleme de Protecţia Plantelor, Institutul de Cercetări pentru Cereale şi Plante Tehnice, Fundulea, Bucureşti, vol XXVI, nr. 1: 33-37.
23. MONTANDON A., 1887 – *Excursions en Dobroudja*, Bulletin de la Societé d`Études scientifiques d`Angers, nouvelle série, Angers, XVI[e] année: 31-64.
24. MONTANDON AL., 1908 – *Notes sur la faune entomologique de la Roumanie*, Additions au catalogue des coléoptères; Buletinul Societăţii de Ştiinţe, Bucureşti, 17: 67-119.
25. MONTANDON AL., 1909 – *Notes sur la faune entomologique de la Roumanie – Coleoptera*; Bulletin de la Societé des Sciences de Bucharest, Bucureşti, an XVI, no. 1-2, :30-60.
26. PERJU T. ROGOJANU V., GRECEA-TARŢÃ AL., 1971 – *Cercetări privind ecologia şi combaterea viermilor sârmă (Elateridae, Coleoptera)*, Studii şi Cercetări de Biologie, seria Zoologie, Ed. Academiei Române, Bucureşti, tome 23, nr. 1: 71-82.
27. PERJU T., MARE I., TARŢĂ AL., 1981 – *Protecţia culturilor agricole împotriva viermilor sârmă*, Casa Agronomului, Mureş: 71.
28. PERJU T., MARE T., 1984 – *Viermi sârmă – Recunoaştere, biologie, ecologie şi combatere*, Ed. Ceres, Bucureşti: 111.
29. PETCU L., MÃRGÃRIT GR., HONDRU N., PAISESCU D., 1995 – *Contribuţii la cunoaşterea viermilor sârmã (Coleoptera, Elateridae) din principalele culturi de câmp din zona Albota – Argeş*; Probleme de Protecţia Plantelor, Institutul de Cercetări pentru Cereale şi Plante Tehnice Fundulea, Bucureşti, vol XXIII, nr. 2: 187-195.
30. PETRI K., 1911 – *Siebenbürgens Käferfauna auf grund ihrer Erforschung bis zum jahre 1911*, Siebenbürgischen verein für Naturwissenschaften zu Hermannstadt, Sibiu, band XV: 196-205.
31. PETRI K., 1912 – *Siebenbürgens Käferfauna.* Sieb. Ver fus Naturwiss zu Hermannstadt, Ergänzungen und Berichtigungen zur Käferfauna Siebenbürgens, Sibiu: 165-199.
32. RADU V. GH, ROGOJANU V., GRECEA AL., TENŢ-DAN FL.– 1962, *Dinamica larvelor de coleoptere în raport cu natura solului şi a vegetaţiei*, Studii şi Cercetări de Biologie, seria Biologie Animalã, Ed. Academiei RPR, Bucureşti, nr. 1, tom XIV:. 65-78
33. RADU V. GH., GRECEA AL., 1963 – *Contribuţii la studiul larvelor de coleoptere din sol (I) – familia Elateridae*, Studii şi Cercetări de Biologie, Ed Academiei RPR, filiala Cluj, vol 1, anul XIV: 81-87
34. RADU V. GH., GRECEA AL., 1965 – *Larve de coleoptere din sol (II) – familia Elateridae*, Studia Universitatis Babeş-Bolýai, Cluj, seria Biologie, fasciculus I: 41-46.
35. RADU V. GH., GRECEA-TARŢÃ AL., 1967 – *Dinamica larvelor de coleoptere din sol tratat cu îngrăşăminte*, Studia Universitatis Babeş-Bolyai, Cluj, Seria Biologie, Fasciculus 2: 71-76.
36. ZAHARIA (CIUCĂ) L., 2004 – *Notă asupra speciilor de elateride (Coleoptera: Elateridae) colectate în Parcul Naţional Piatra Craiului în Tabăra Entomologică 2004,* Studii şi Comunicări – Ştiinţele Naturii, Craiova, vol XX: 185-188.
37. ZAHARIA (CIUCĂ) L., CHIMIŞLIU C., 2004 – *Catalogul elateridelor (Coleoptera: Elateridae) din patrimoniul Secţiei de Ştiinţele Naturii a Muzeului Olteniei, Craiova,* Studii şi Comunicări – Ştiinţele Naturii, Craiova, vol XX,: 152-158.

Tab. 1 - List of Elateridae species (Elateridae, Coleoptera) identified in Romania

No.	Specie	Petri (1911-1912)	Deubel (1912)	Marcu (Brașov collection)	Bobârnac, Chimișliu (1999)	Montandon	Bile (1887)	Keanu (1972 – 1973)	Denial (1970)	Fleck (1906)	Jacque (1898-1903)	Manlike (1930-1969)	Manhole (1991,1996)	Margi (1990,1998)	Montandon (1887, 1908, 1909)	Peru et cool (1963, 1967 1970)	Personal identified
Subfamily Pyrophorinae																	
1.	*Lacon lepidopterus* (Panzer, 1801)	+	+			+	+			+		+			+		
2.	*Lacon querceus* (Herbst, 1784)	+	+				+										
3.	*Lacon punctatus* (Herbst, 1779)	+	+			+	+			+					+		
4.	*Danosoma fasciata* (Linnaeus, 1758)	+	+			+	+	+	+	+					+		
5.	*Agrypnus murinus* (Linnaeus, 1758)	+		+	+	+	+	+	+	+	+	+			+	+	+
6.	*Drasterius bimaculatus* (Rossi, 1790)	+	+	+		+	+			+	+	+	+	+	+		+
7.	*Aeoloderma crucifer* (Rossi, 1790)					+				+					+		+
Subfamily Elaterinae																	
8.	*Ampedus cinnabarinus* (Eschscholtz, 1829)	+	+			+	+			+	+				+		+
9.	*Ampedus sanguineus* (Linnaeus, 1758)	+	+	+	+	+	+	+		+		+			+		+
10.	*Ampedus quadrisignatus* (Gyllenhall, 1817)	+	+														
11.	*Ampedus rufipennis* **(**Stephens, 1830)	+		+		+											+
12.	*Ampedus pomonae* (Stephens, 1830)	+	+			+											
13.	*Ampedus sanguinolentus* (Schrank, 1776)	+	+	+	+	+	+	+		+	+	+			+		+
14.	*Ampedus nigroflavus* (Goeze, 1777)	+	+	+		+	+			+		+			+		+
15.	*Ampedus pomorum* (Herbst, 1784)	+	+			+	+	+	+	+		+					+
16.	*Ampedus glycereus* (Herbst, 1784)	+	+			+	+			+					+		+
17.	*Ampedus elegantulus* (Schönherr,1817)	+	+			+	+								+		+
18.	*Ampedus balteatus* (Linnaeus, 1758)	+	+			+	+	+							+		+
19.	*Ampedus praeustus* (Fabricius, 1792)	+	+				+			+							
20.	***Ampedus cardinalis*** (Schiődte, 1865)	**new specie for Romania**															+
21.	*Ampedus tristis* (Linnaeus, 1758)	+	+			+				+					+		
22.	*Ampedus sinuatus* (Germar, 1844)	+	+	+			+										+
23.	*Ampedus erythrogonus* (Müller, 1821)	+	+			+	+			+					+		+
24.	*Ampedus aethiops* (Lacordaire, 1835)	+		+		+	+		+	+					+		
25.	*Ampedus nigerrimus* (Lacordaire, 1835)	+				+	+			+							+
26.	*Ampedus nigrinus* (Paykull, 1784)	+	+			+	+			+		+			+		
27.	*Brachygonus ruficeps* (Mulsant, 1855)	+	+				+										+
28.	*Brachygonus megerlei* (Lacordaire, 1835)	+	+			+	+								+		+
29.	*Ischnodes sanguinicollis* (Panzer, 1793)	+					+										

No.	Specie	Petri (1911-1912)	Deubel (1912)	Marcu (Brașov collection)	Bobârnac, Chimișliu (1999)	Montandon	Bile (1887)	Keanu (1972 – 1973)	Denial (1970)	Fleck (1906)	Jacque (1898-1903)	Manlike (1930-1969)	Manhole (1991,1996)	Margi (1990,1998)	Montandon (1887, 1908, 1909)	Peru et cool (1963, 1967 1970)	Personal identified
30.	*Procaerus tibialis* (Boisduval & Lacordaire, 1835)	+	+			+	+										
31.	*Megapenthes lugens* (Redtenbacher, 1842)	+					+								+		
32.	*Porthmidius austriacus* (Schrank, 1781)	+	+														
33.	*Podeonius acuticornis* (Germar, 1824)	+					+										
34.	*Idolus picipennis* (Bach, 1852)	+	+			+	+	+		+							+
35.	*Betarmon bisbimaculatus* (Fabricius, 1803)	+	+			+											
36.	*Elater ferrugineus* (Linnaeus, 1758)	+	+	+			+			+		+			+		+
37.	*Sericus brunneus* (Linnaeus, 1758)	+	+			+	+	+		+		+					+
38.	*Sericus subaeneus* (Redtenbacher, 1842)						+										
39.	*Ectinus aterrimus* (Linnaeus, 1761)	+	+			+	+					+				+	+
40.	*Agriotes acuminatus* (Stephens, 1830)	+	+		+		+										+
41.	*Agriotes pallidulus* (Illiger, 1758)	+					+										
42.	*Agriotes gallicus* (Boisduval & Lacordaire, 1835)	+	+	+													+
43.	*Agriotes ustulatus* (Schaller, 1767)	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+
44.	*Agriotes pilosellus* (Schönherr, 1817)	+	+		+	+	+			+		+		+	+		+
45.	*Agriotes brevis* (Candèze, 1863)					+											+
46.	*Agriotes sputator* (Linnaeus, 1758)	+	+	+		+	+			+	+	+		+	+	+	+
47.	*Agriotes lineatus* (Linnaeus, 1758)	+				+	+					+		+	+	+	+
48.	*Agriotes obscurus* (Linnaeus, 1758)	+	+			+	+	+				+	+	+		+	+
49.	***Agriotes modestus*** (Kiesenwetter, 1858)	**new specie for Romania**															+
50.	*Agriotes gurgistanus* (Faldermann 1835)					+				+					+		
51.	*Agriotes rufipalpis* (Brullé, 1848)	+				+	+					+					+
52.	*Dalopius marginatus* (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+	+						+
53.	*Synaptus filiformis* (Fabricius, 1781)	+	+			+	+	+	+	+	+	+			+		+
54.	*Adrasus limbatus* (Fabricius, 1776)	+	+	+	+	+	+			+		+	+			+	+
55.	*Adrasus axillaris* (Erichson, 1842)						+										+
56.	*Adrasus lacertosus* (Erichson, 1842)	+	+	+		+											
57.	*Adrasus pallens* (Fabricius, 1792)	+	+	+		+	+	+									+
58.	*Adrasus rachifer* (Fourcroy, 1785)	+	+	+	+	+									+		+
59.	*Adrasus montanus* (Scopoli, 1763)	+	+	+	+	+	+										+
Subfamily Hypnoidinae																	
60.	*Hypnoidus riparius* (Fabricius, 1792)	+				+	+			+						+	

No.	Specie	Petri (1911-1912)	Deubel (1912)	Marcu (Brașov collection)	Bobârnac, Chimișliu (1999)	Montandon	Bile (1887)	Keanu (1972 – 1973)	Denial (1970)	Fleck (1906)	Jacque (1898-1903)	Manlike (1930-1969)	Manhole (1991,1996)	Margi (1990,1998)	Montandon (1887, 1908, 1909)	Peru et cool (1963, 1967 1970)	Personal identified
61.	*Hypnoidus consobrinus* (Mulsant & Guillebeau, 1855)					+											+
62.	*Hypnoidus rivularius* (Gyllenhall, 1808)	+					+			+							
	Subfamily Negastriinae																
63.	*Oedostethus 4-pustulatus* (Fabricius, 1792)	+		+			+			+							
64.	*Oedostethus tenuicornis* (Germar, 1824)	+															
65.	*Fleutiauxellus maritimus* (Curtis, 1840)					+				+							
66.	*Quasimus minutissimus* (Germar, 1817)	+	+			+	+										
67.	*Negastius pulchellus* (Linnaeus, 1761)	+	+	+			+										
68.	*Negastius sabulicola* (Boheman, 1851)						+										
69.	*Zorochus meridionalis* (Laporte de Castelnau, 1840)	+	+			+	+	+									
70.	*Zorochus quadriguttatus* (Laporte de Castelnau, 1840)									+					+		
71.	*Zorochus flavipes* (Aubé, 1850)					+											
72.	*Zorochus dermestoides* (Herbst, 1806)	+	+	+		+	+								+		
	Subfamily Cardiophorinae																
73.	*Cardiophorus gramineus* (Scopoli, 1763)	+	+		+		+					+					+
74.	*Cardiophorus discicollis* (Herbst, 1806)					+				+	+						+
75.	*Cardiophorus rufficolis* (Linnaeus, 1758)	+	+				+										
76.	*Cardiophorus rufipes* (Goeze, 1777)	+	+			+	+										+
77.	*Cardiophorus nigerrimus* (Erichson, 1840)	+		+	+	+											
78.	*Cardiophorus vestigialis* (Erichson, 1840)						+			+	+						+
79.	*Cardiophorus biguttatus* (Olivier, 1790)	+										+					
80.	*Cardiophorus ebeninus* (Germar, 1824)									+	+						
81.	***Cardiophorus asellus*** (Erichson, 1840)	**new specie for Romania**															+
82.	*Dicronychus cinereus* (Herbst, 1784)	+	+				+			+	+						+
83.	*Dicronychus equiseti* (Herbst, 1784)	+	+			+	+			+	+				+		+
84.	*Dicronychus rubripes* (Germar, 1824)	+	+	+		+	+			+	+						+
85.	***Paracardiophorus musculus*** (Erichson, 1840)	**new specie for Romania**															+
	Subfamily Melanotinae																
86.	*Melanotus rufipes* (Herbst, 1784)	+	+		+	+	+	+		+	+	+	+		+	+	+
87.	*Melanotus castanipes* (Paykull, 1800)					+	+			+	+	+					+
88.	*Melanotus crassicollis* (Erichson, 1841)	+	+			+	+			+		+	+	+	+	+	+

No.	Specie	Petri (1911-1912)	Deubel (1912)	Marcu (Brașov collection)	Bobârnac, Chimișliu (1999)	Montandon	Bile (1887)	Keanu (1972 – 1973)	Denial (1970)	Fleck (1906)	Jacque (1898-1903)	Manlike (1930-1969)	Manhole (1991,1996)	Margi (1990,1998)	Montandon (1887, 1908, 1909)	Peru et cool (1963, 1967 1970)	Personal identified
89.	*Melanotus punctolineatus* (Pélerin, 1829)	+	+		+	+	+		+	+	+	+		+	+	+	+
90.	*Melanotus tenebrosus* (Erichson, 1841)	+	+			+									+		+
91.	*Melanotus brunnipes* (Germar, 1824)	+	+	+	+	+	+		+	+	+	+	+		+	+	+
92.	*Melanotus villosus* (Fourcroy, 1785)				+	+				+			+				+
Subfamily Dendrometrinae																	
93.	*Cidnopus pilosus* (Leske, 1785)	+	+		+	+	+	+		+	+	+		+	+	+	+
94.	*Cidnopus aeruginosus* (Olivier, 1790)	+	+			+	+	+		+	+	+			+	+	+
95.	*Limonius minutus* (Linnaeus, 1758)	+	+			+	+	+	+	+	+	+				+	+
96.	*Nothodes parvulus* (Panzer, 1799)	+	+	+		+	+	+	+	+				+	+		+
97.	*Pheletes aeroniger* (de Geer, 1774)	+	+			+	+										
98.	*Pheletes quercus* (Olivier, 1790)	+	+	+			+										+
99.	*Stenagostus villosus* (Fourcroy, 1785)	+				+	+			+	+						
100.	*Hemicrepidius hirtus* (Herbst, 1784)	+	+				+					+	+				+
101.	*Hemicrepidius niger* (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+
102.	***Crepidophorus mutilatus*** (Rosenhauer, 1847)	**new specie for Romania**															+
103.	*Alcimathous sacheri* (Kiesenwetter, 1858)					+				+				+	+		+
104.	*Athous (Athous) vittatus* (Fabricius, 1792)	+	+	+		+	+		+	+	+	+			+		+
105.	*Athous (Athous) hamorrhoidalis* (Fabricius,1801)	+	+	+	+	+	+	+		+		+	+	+	+	+	+
106.	*Athous (Haplathous) subfuscus* (Müller, 1767)	+	+		+	+	+	+	+	+	+	+			+	+	+
107.	*Athous (Haplathous) zebei* (Bach, 1854)	+					+										+
108.	*Athous (Haplathous) carpathicus* (Reitter, 1905)	+															
109.	*Athous (Haplathous) mollis* (Reitter, 1889)	+	+			+				+	+						+
110.	*Athous (Haplathous) austriacus* (Desbrochers, 1873)	+	+														+
111.	*Athous (Orthathous) bicolor* (Goeze, 1777)	+	+			+	+										+
112.	***Athous (Orthathous) jejunus*** (Kiesewetter, 1858)	**new specie for Romania**															+
113.	*Athous (Orthathous) campyloides* (Newmann, 1833)	+	+				+										+
114.	*Diacanthous undulatus* (de Geer, 1774)	+	+	+		+	+	+		+					+		+
115.	*Denticollis linearis* (Linnaeus, 1758)	+	+				+	+	+	+					+		+
116.	*Denticollis rubens* (Piller & Mitterpacher, 1783)	+	+				+										
117.	*Dima elateroides* (Charpentier, 1825)	+	+				+										+
118.	*Ctenicera virens* (Schrank, 1781)	+	+		+	+	+	+		+					+		+
119.	*Ctenicera pectinicornis* (Linnaeus, 1781)	+	+		+	+	+			+	+	+	+				+

No.	Specie	Petri (1911-1912)	Deubel (1912)	Marcu (Brașov collection)	Bobârnac, Chimișliu (1999)	Montandon	Bile (1887)	Keanu (1972 – 1973)	Denial (1970)	Fleck (1906)	Jacque (1898-1903)	Manlike (1930-1969)	Manhole (1991,1996)	Margi (1990,1998)	Montandon (1887, 1908, 1909)	Peru et cool (1963, 1967 1970)	Personal identified
120.	*Ctenicera heyeri* (Saxesen, 1838)	+	+	+		+	+										+
121.	*Ctenicera cuprea* (Fabricius, 1781)	+	+	+	+	+	+	+	+	+	+	+			+		+
122.	*Anostirus purpureus* (Poda, 1761)	+	+			+	+	+				+					+
123.	*Anostirus castaneus* (Linnaeus, 1758)	+				+		+							+		+
124.	*Anostirus sulphuripennis* (Germar, 1843)						+										
125.	*Actenicerus sjaelandicus* (Müller, 1764)	+	+		+	+	+		+	+	+	+				+	+
126.	*Aplotarsus incanus* (Gyllenhal, 1827)				+												+
127.	*Selatosomus aeneus* (Linnaeus, 1758)	+	+	+		+	+		+	+	+	+			+	+	+
128.	*Selatosomus gravidus* (Germar, 1843)	+	+	+		+	+			+	+				+	+	+
129.	*Selatosomus amplicollis* (Germar, 1843)	+	+				+					+					+
130.	*Selatosomus* (*Pristilophus*) *melancholicus* (Fabricius, 1798)	+					+										+
131.	*Selatosomus* (*Pristilophus*) *cruciatus* (Linnaeus, 1758)	+															+
132.	*Metanomus infuscatus* (Eschscholtz, 1829).	+	+				+			+							+
133.	*Paraphotistus impressus* (Fabricius, 1792)	+	+	+			+					+					+
134.	*Paraphotistus nigricornis* (Panzer, 1799)	+	+				+									+	+
135.	*Neopristilophus insitivus* (Germar, 1824)	+		+		+	+										
136.	*Pseudanostirus globicollis* (Germar, 1843)		+			+											
137.	*Calambus bipustulatus* (Linnaeus, 1767)	+	+				+			+	+						+
138.	*Eanus guttatus* (Germar 1817)	+	+			+	+			+							+
139.	*Hypoganus inunctus* (Panzer, 1794)	+	+				+										+
140.	*Liotrichus affinis* (Paykull, 1800l)	+	+	+	+	+	+		+	+					+		+
141.	*Prostenon tessellatum* (Linnaeus, 1758)	+	+	+		+	+	+		+	+	+	+		+	+	+
142.	*Orithales serraticornis* (Paykull, 1800)	+				+											

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE BIODIVERSITY OF CLICK BEETLES SPECIES IDENTIFIED IN GRASSLAND ECOSYSTEMS FROM EAST PART OF ROMANIA

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ABSTRACT

ZAHARIA L., 2006 - The biodiversity of click beetles species identified in grassland ecosystems from East part of Romania. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 293-298.

The study represent and ecological analyzes of the elaterids species collected in the period 2000-2004 in grassland ecosystems at different high with respect to vegetation altitude spreading. During the research period were collected a number of 1173 click beetles specimens both from the East part of Romania (Moldavia) and national Park Piatra Craiului. There were identified 60 species from 24 genera included in 5 subfamilies.

Key words: biodiversity, Elateridae, grassland, Romania

Introduction

Click beetles species spread in grasslands ecosystems have larval development in soil during 3-4-5 year depending on the altitude. These species larval stages feed on vegetation roots or rotten vegetal matter, rarely being predators. Some of the elaterid species spread in this ecosystem are pest, producing great damage in different crops. Rarely , in these type of ecosystem appear forest species due to the fact that most of adults feed on flower for maturation.

Material and methods

The study is based on a number of 1173 click beetles specimens collected by sweeping the vegetation with entomological net in different ecosystem from Moldavia and National Park Piatra Craiului. From Moldavia were collected click beetles from the following 85 localities: Adjud (BC); Adâncata (SV); Agapia (NT); Arama (SV); Bacău (BC); Băceşti (VS); Bârnova (IS); Breazu (IS); Bereşti – Tazlău (BC); Berzunţi (BC); Bijghir (BC); Botoşani (BT); Brusturoasa (BC); Buhoci (BC); Buhuşi (BC); M. Călimani (SV); Căşerie (BC); Ceahlău (NT); Codri Slătioara (SV); Copălău (BT); Coşula (BT); Coţofăneşti (BC); Dofteana (BC); Dumbrava (NT); Durău (NT); Fântânele (NT); Fântânele (BC); Filipeşti (BC); Gherăieşti (BC); Grigoreni (BC); Gura Humorului (SV); Gura Văii (BC); Hemeiuşi (BC); Iaşi (IS); Ilişeşti (SV); Ion Creangă (NT); Iteşti (BC); Lespezi (BC); Livezi (BC); Luizi Călugăra (BC); Luncani (BC); Măgura (BC); Mănăstirea Caşin (BC); Mărăşeşti (VN); M. Nemira (BC); Nicolae Bălcescu (BC); Onişcani (BC); Parincea (BC); Păltinoasa (SV); Perchiu (BC); Plopana (BC); Poiana Sărată (BC); Potoci (NT); Prăjeşti (BC); Vf. Pufu-Slănicel (BC); Racova (BC); Răchitoasa (BC); Răcăciuni (BC); M-ţii Rodnei-Pârâul Lala (SV); Roman (NT); Runc (BC); Salcea (SV); Sascut (BC); Sărărie (BC); Slănic Moldova (BC); Secuieni (BC); Şerbeşti (BC); Strugari (BC); Suceava (SV); Tamaşi (BC); Tazlău (BC); Tescani (BC); Traian (BC); Trebeş (BC); Truşeşti (BT); Urecheşti (BC); Valea Budului (BC); Valea Uzului (BC); Valea Seacă (BC); Vatra Dornei (SV); Văculeşti (SV); Văratic (NT); Vânători (NT); Zeletin (BC); Zboina (BC). In National Park Piatra Craiul were sampled click beetles species from 8 locations: Măgura Hill, Zărneşti Gorges, Sătic, Bârsa Valley, Bârsa Tamaşului, Hora cu Brazi, Piatra Mică, Crăpătura.

The species identified in the studied ecosystems were analyzed using the ecological index: abundance, dominance, constancy and Dzuba index. The data were analyzed with Biodiversity Pro and the dendrogram was drawn up using Bray-Curtis method.

Results and discussions

There were identified a number of 60 species for grassland ecosystem belonging to 24 genera and 60 subfamilies (Pyrophorinae, Elaterinae, Cardiophorinae, Melanotinae, and Dendrometrinae).

subfamily **Pyrophorinae**:

genus *Agrypnus*: *Agrypnus murinus*;

[*] "Ion Borcea" Natural Sciences Museum Complex

subfamily **Elaterinae** with 7 genera and 24 species:

genus *Brachygonus*: *Brachygonus megerlei* and *B. rufipennis*;

genus *Ampedus*: *Ampedus sinuatus*, *A. balteatus*, *A. nigerrimus*, *A. nigroflavus*, A. *sanguineus*, *A. sanguinolentus*, *A. pomorum* and *A. elongatulus*;

genus *Idolus* with one species - *I. picipennis*;

genus *Agriotes*: *A. aterrimus*, *A. acuminatus*, *A. pilosellus*, *A. ustulatus*, *A. gallicus*, *A. lineatus*, *A. sputator*, *A. obscurus* and *A. brevis*;

genus *Dalopius* with one species – *D. marginatus*,

genus *Synaptus* with one species - *S. filiformis*;

genus *Adrastus* with two species: *A. rachifer* şi *A. limbatus*;

subfamily **Cardiophorinae** out of which was identified one genera with one species:

genus *Dichronychus*: *D. cinereus*;

subfamily **Melanotinae** with five species from *Melanotus* genus:

M. brunnipes, *M. rufipes*, *M. castanipes*, *M. tenebrosus* şi *M. crassicollis*;

subfamily **Dendrometrinae** with 13 genera which include 29 species:

genus *Cidnopus* - *C. pilosus*;

genus *Nothodes* - *N. parvulus*;

genus *Diacanthous* - *D. undulatus*;

genus *Hemicrepidius*: - *H. niger* and *H. hirtus*;

genus *Crepidophorus* - *C. mutilatus*;

genus *Athous* which includes 10 species: *A. sacheri*, *A. haemorrhoidalis*, *A. vittatus*, *A. subfuscus*, *A. zebei*, *A. mollis*, *A. austriacus*, *A. jejunus*, *A. bicolor* and *A. campyloides*;

genus *Ctenicera* with three species: *C. heyeri*, *C. pectinicornis* and *C. cuprea*;

genus *Anostirus* – *A. purpureus*;

genus *Selatosomus* with three species: *S. amplicollis*, *S. aeneus*, *S. gravidus*;

genus *Calambus* - *C. bipustulatus*;

genus *Prosternon* – *P. tessellatum*;

genus *Denticollis* - *D. linearis*.

In table 1 is presented the abundance and dominance of the species identified in each grasslands ecosystem with respect to altitude of vegetation spreading.

Out of the table we can draw up the following:

- from the grassland placed in river valleys were identified as eudominant the following species: *Agriotes ustulatus* (D = 22,09), *Cidnopus pilosus* (D = 15,95) and *Selatosomus gravidus* (D = 12,27) and, also, in these ecosystems was identified high a number of specimens belonging to *Hemicrepidius niger* (D = 9,2) and *Athous haemorrhoidalis* (D =7,98);
- in forest steppe region the click beetles fauna is dominated by the following species *Synaptus filiformis* (D = 25,58), *Melanotus castanipes* (D = 11,63), *Hemicrepidius niger* (D = 11,63) and *Cidnopus pilosus* (D = 6,98);
- the elaterids fauna of grassland ecosystem from hill region numbers 39 species out of which high values of dominance and abundance were recorded for *Agriotes ustulatus* (D = 24,34), *Cidnopus pilosus* (D = 12,5), *Agrypnus murinus* (D = 8,8) *Melanotus crassicollis* (D = 5,92) and *Hemicrepidius niger* (5,92);
- the click beetles fauna from mountain grassland ecosystem include a number of 47 species from which the following are dominant and eudominant: *Hemicrepidius niger* (D = 33,44), *Ctenicera cuprea* (D = 25,51) and *Agrypnus murinus* (D =6,22);
- in alpine region of Piatra Craiului National Park were identified 5 species among which the highest abundance was recorded for *Ctenicera cuprea.*

The ecological analyses for elaterid species emphasize a total number of 9 euconstat species and 12 constant species for the five type of grassland ecosystems. All the species from *Ampedus* genus appears accidentally or accessory for grassland ecosystems due to the fact that their larval stages develop in rotten wood of different deciduous and resinous species in forest ecosystems. Eudominat species for all grassland ecosystems are *Hemicrepidius niger* (D_5 = 21,57 %), *Ctenicera cuprea* (D_5 = 15,35 %) and *Agriotes ustulatus* (D_5 = 10,91 %). In these ecosystems were identified two dominate species: *Cidnopus pilosus* (D_4 = 7,76 %) and *Agrypnus murinus* (D_4 = 6,48 %) (table 2).

From the ecological significance index (W) point of view the characteristic species grassland ecosystems are: *Hemicrepidius niger* (W_5 = 21,57), *Ctenicera cuprea* (W_4 = 12,28), *Agriotes ustulatus* (W_4 = 6,55), *Cidnopus pilosus* (W_4 = 6,21) and *Agrypnus murinus* (W_4 = 5,18). *Hemicrepidius niger* is very abundant in hill and mountain region, and *Ctenicera cuprea* in mountain areas (table 2).

Using ecological similarity Jaccard index and Biodiversity Pro for statistical analyses we obtain a dendrogram for colleted species from grassland ecosystem. Due to different collecting period and the great number of stationeries were undertaken only qualitative analyses for these ecosystems.

In figure 1 is presented the dendrogram of collected species drown up on the ecological affinity basis calculated through Bray-Curtis method. From this dendrogram results great affinities for the following species:

- *Denticollis linearis* and *Selatosomus amplicollis* both spread in mountains lawns;
- *Ampedus sanguinolentus* and *A. sanguineus* – species with larval development in rotten trunks from river meadows and forest steppe region;
- *Ampedus balteatus* and *Ampedus rufipennis* – which are spread in forest ecosystems, accidentally in grasslands, *A. rufipennis* –

with larval development in rotten beech trunks and *A. balteatus* in rotten resinous trunks;
- *Dalopius marginatus* and *Agriotes obscurus* – species spread in deciduous forests and lawns from low altitude mountain areas, hill and plane regions;
- *Ampedus nigerrimus* and *Actenicerus sjaelandicus* – species spread in grassland ecosystem from plane to alpine region;
- *Ctenicera heyeri* and *Melanotus rufipes* – spread in hill region;
- *Anostirus purpureus* and *Ampedus pomorum* – accidentally in grassland ecosystems, these two are forest species with larval development in rotten trunks;
- *Hemicrepidius niger, Cidnopus pilosus, Agriotes ustulatus, Prosternon tessellatum, Selatosomus gravidus* and *Agrypnus murinus* – generally ubiquist species spread both in natural and anthropic ecosystems from hill to mountain regions, with larval development in soil.

Conclusions

There were identified a number of 60 species for grassland ecosystem belonging to 24 genera and 60 subfamilies (Pyrophorinae, Elaterinae, Cardiophorinae, Melanotinae, and Dendrometrinae). The ecological analyses for elaterid species collected in grassland ecosystems emphasize a number of 9 euconstat species and 12 constant species. Eudominat species for all grassland ecosystems are *Hemicrepidius niger*, *Ctenicera cuprea*, and *Agriotes ustulatus*. From the ecological significance index point of view the characteristic species for grassland ecosystems are: *Hemicrepidius niger* , *Ctenicera cuprea*, *Agriotes ustulatus, Cidnopus pilosus* and *Agrypnus murinus*.

References

1. BARBAULT R. 1995 - *Écologie générale. Structure et fonctionnement de la biosphère,* Ed. Masson, Paris, 275 pg.
2. BARSEVSKIS A., 2005 - *Catalogue of click - beetles (Coleoptera: Elateridae) of Latvia*, Proceedings on Taxonomy and Faunistics of Beetles (Coleoptera) dedicated to the 100th birthday of the Latvian entomologist Mihails Stiprais *(1905 - 1990)*, pg 7-28.
3. CIORNEI C-TIN, CIUCĂ L., 2002 - *The influence of chemical treatments used for root pests control in forest nurseries on the diversity of soil fauna*, Analele Ştiinţifice ale Universităţii „al. I. Cuza" Iaşi, Iaşi, Tome XLVIII, Ed. Univ. „Al. I. Cuza", pg. 44-55.
4. CIUCĂ L., CIORNEI C-TIN, 2002 - *Researches regarding the spreading of elaterid species in forest nurseries from oak region in Moldova*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Tom XLVIII, Iaşi: 55-61.
5. CIUCĂ L., CIORNEI C-TIN, 2003 - *Biodiversitatea speciilor de elateride (Coleoptera: Elateridae) din Parcul Dendrologic Hemeiuşi*, Lucrările celei de a 6-a Conferinţe Naţionale pentru Protecţia Mediului prin Mijloace Biologice şi Biotehnice şi a celei de a 3 - a Conferinţe Naţionale de Ecosanogeneză, Braşov: 254-261.
6. CIUCĂ L., MUSTAŢĂ GH., 2003 - *The biodiversity of click beetles (Coleoptera: Elateridae) from Moldavia*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Tom XLIX, Iaşi: 41-52.
7. CIUCĂ L., 2003 - *The catalogue of click beetles species (Elateridae, Coleoptera) identified in Moldavia*, Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie Animală, Tom XLIX, Iaşi: 95-109.
8. DONIŢĂ N. şi col., 1992 - *Vegetaţia României*, Ed. Tehnică Agricolă, Bucureşti, 407 pg.
9. IONESCU M, FESCI S., 1969 - *Cercetări preliminare privind entomofauna unor păşuni alpine din Munţii Cibinului*, Studii şi Cercetări de Biologie, seria Zoologie, tome 21, nr. 6; ed. Academiei RSR, Bucureşti: 483-499.
10. LESEIGNEUR L., 1972 - *Coléoptéres Elateridae de la Faune de France continentale et de Corse*. Suppl. Bull. Mens. Soc. Linn. Lyon, (Suppl.) 41: 1-379.
11. LOHSE A., 1979 – *Elateridae*. *In*: Freude H., Harde K.W. & Lohse G.A., *Die Käfer Mitteleuropas, 6*. Goecke & Evers, Krefeld: 103-186.
12. MAGURRAN A., 1955 - *Ecological diversity and its measurement.* University Press Cambridge, 179 pg.
13. PERJU T., MARE T. 1984 - *Viermi sârmă – Recunoaştere, biologie, ecologie şi combatere*, Ed. Ceres, Bucureşti, 111 pg.
14. VARVARA M., ZAMFIRESCU S., NEACŞU P., 2001 - *Lucrări practice de ecologie (manual).* Ed. Universităţii „Al. I. Cuza", Iaşi, 151 pg.
15. ZAHARIA (CIUCĂ) L., 2004 - *Notă asupra speciilor de elateride (Coleoptera: Elateridae) colectate în Parcul Naţional Piatra Craiului în Tabăra Entomologică 2004,* Studii şi Comunicări – Ştiinţele Naturii, vol XX, Craiova: 185-188.
16. ZAHARIA (CIUCĂ) L., CHIMIŞLIU C., 2004 - *Catalogul elateridelor (Coleoptera: Elateridae) din patrimoniul Secţiei de Ştiinţele Naturii a Muzeului Olteniei, Craiova,* Studii şi Comunicări – Ştiinţele Naturii, vol XX, Craiova: 152-158.

Tab. 1 - The abundance and dominance of elaterids species collected in calculated for each type of grassland ecosystem with respect to altitude

No	Species	Grassland ecosystems										
		meadow		**forest steppe**		**hill and plateau**		**mountain**		**alpine**		**total**
		A	$D_{(\%)}$	A	$D_{(\%)}$	A	$D_{(\%)}$	A	$D_{(\%)}$	A	$D_{(\%)}$	
1.	*Agrypnus murimus*	8	4.91	1	2.33	27	8.88	40	6.22			76
2.	*Brachygonus megerlei*			1	2.33	1	0.33					2
3.	*Ampedus rufipnenis*	1	0.61									1
4.	*Ampedus sinuatus*	1	0.61	1	2.33							2
5.	*Ampedus balteatus*					1	0.33	1	0.16			2
6.	*Ampedus nigerrimus*							2	0.31			2
7.	*Ampedus nigroflavus*							1	0.16			1
8.	*Ampedus sanguineus*					1	0.33	1	0.16			2
9.	*Ampedus sanguinolentus*					2	0.66	1	0.16			3
10.	*Ampedus pomorum*							4	0.62			4
11.	*Ampedus elongatulus*							1	0.16			1
12.	*Idolus picipennis*							3	0.47	2	10	5
13.	*Agriotes aterimus*					2	0.66	1	0.16			3
14.	*Agriotes acuminatus*					2	0.66	1	0.16			3
15.	*Agriotes pilosellus*	1	0.61	1	2.33	9	2.96	2	0.31			13
16.	*Agriotes ustulatus*	36	22.09			74	24.34	18	2.80			128
17.	*Agriotes gallicus*	9	5.52			3	0.99	3	0.47			15
18.	*Agriotes lineatus*					15	4.93	1	0.16			16
19.	*Agriotes sputator*					13	4.28	6	0.93			19
20.	*Agriotes brevis*	2	1.23									2
21.	*Agriotes obscurus*	1	0.61			1	0.33	5	0.78			7
22.	*Dalopius marginatus*					1	0.33	17	2.64			18
23.	*Synaptus filiformis*			11	25.58	1	0.33	2	0.31			14
24.	*Adrastus rachifer*			1	2.33	1	0.33					2
25.	*Adrastus limbatus*			1	2.33	1	0.33					2
26.	*Dicronychus cinereus*	3	1.84									3
27.	*Melanotus brunnipes*					4	1.32	1	0.16			5
28.	*Melanotus rufipes*			1	2.33	1	0.33	2	0.31			4
29.	*Melanotus castanipes*			5	11.63			1	0.16			6
30.	*Melanotus tenebrosus*	2	1.23									2
31.	*Melanotus crassicollis*	3	1.84			18	5.92	2	0.31			23
32.	*Cidnopus pilosus*	26	15.95	3	6.98	38	12.50	24	3.73			91
33.	*Notodes parvulus*			1	2.33	5	1.64	1	0.16			7
34.	*Harminius undulatus*							1	0.16			1
35.	*Hemicrepidius niger*	15	9.20	5	11.63	17	5.59	215	33.44	1	5	253
36.	*Hemicrepidius hirtus*	4	2.45	2	4.65	4	1.32	15	2.33			25
37.	*Crepidophorus mutilatus*	1	0.61			1	0.33	6	0.93			8
38.	*Athous sacheri*	1	0.61	1	2.33	4	1.32					6
39.	*Athous haemorrhoidalis*	13	7.98	1	2.33	8	2.63	6	0.93			28
40.	*Athous vittatus*			1	2.33	3	0.99					4
41.	*Athous subfuscus*	1	0.61	1	2.33	1	0.33	29	4.51			32
42.	*Athous zebei*							11	1.71			11
43.	*Athous mollis*							4	0.62			4
44.	*Athous austriacus*	1	0.61			3	0.99	8	1.24	1	5	13
45.	*Athous jejunus*					1	0.33					1
46.	*Athous bicolor*	1	0.61	1	2.33			1	0.16			3
47.	*Athous campyloides*	4	2.45			8	2.63	2	0.31			14
48.	*Dima elateroides*							1	0.16			1
49.	*Ctenicera heyeri*			1	2.33	1	0.33	9	1.40			11
50.	*Ctenicera pectinicorni*s							8	1.24			8
51.	*Ctenicera cuprea*	1	0.61	1	2.33			164	25.51	14	70	180
52.	*Ctenicera virens*							2	0.31			2
53.	*Anostirus purpureu*	1	0.61					1	0.16			2
54.	*Actenicerus sjaelandicus*					1	0.33	2	0.31			3
55.	*Selatosomus amplicollis*					2	0.66					2
56.	*Selatosomus aeneus*	1	0.61					3	0.47			4
57.	*Selatosomus gravidus*	20	12.27			15	4.93	5	0.78			40
58.	*Clambus bipustulatus*			1	2.33							1
59.	*Denticolis linearis*					1	0.33	1	0.16			2
60.	*Prosternon tessellatum*	6	3.68	1	2.33	13	4.28	8	1.24	2	10	30
Total		163	100	43	100	304	100	643	100	20	100	1173

Tab. 2 - The ecological analyses of click beetles species identified in grassland ecosystem from Moldavia and National Park Piatra Craiului

Nr. crt	SPECIA	A	D		C		W	
1.	*Agrypnus murimus*	76	6.48	$\mathbf{D_4}$	80	$\mathbf{C_4}$	5.18	$\mathbf{W_4}$
2.	*Brachygonus megerlei*	2	0.17	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.07	$\mathbf{W_1}$
3.	*Brachygonus rufipnenis*	1	0.09	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.02	$\mathbf{W_1}$
4.	*Ampedus sinuatus*	2	0.17	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.07	$\mathbf{W_1}$
5.	*Ampedus balteatus*	2	0.17	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.07	$\mathbf{W_1}$
6.	*Ampedus nigerrimus*	2	0.17	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.03	$\mathbf{W_1}$
7.	*Ampedus nigroflavus*	1	0.09	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.02	$\mathbf{W_1}$
8.	*Ampedus sanguineus*	2	0.17	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.07	$\mathbf{W_1}$
9.	*Ampedus sanguinolentus*	3	0.26	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.10	$\mathbf{W_2}$
10.	*Ampedus pomorum*	4	0.34	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.07	$\mathbf{W_1}$
11.	*Ampedus elongatulus*	1	0.09	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.02	$\mathbf{W_1}$
12.	*Idolus picipennis*	5	0.43	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.17	$\mathbf{W_2}$
13.	*Agriotes aterimus*	3	0.26	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.10	$\mathbf{W_2}$
14.	*Agriotes acuminatus*	3	0.26	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.10	$\mathbf{W_2}$
15.	*Agriotes pilosellus*	13	1.11	$\mathbf{D_2}$	80	$\mathbf{C_4}$	0.89	$\mathbf{W_2}$
16.	*Agriotes ustulatus*	128	10.91	$\mathbf{D_5}$	60	$\mathbf{C_3}$	6.55	$\mathbf{W_4}$
17.	*Agriotes gallicus*	15	1.28	$\mathbf{D_2}$	40	$\mathbf{C_2}$	0.51	$\mathbf{W_2}$
18.	*Agriotes lineatus*	16	1.36	$\mathbf{D_2}$	40	$\mathbf{C_2}$	0.55	$\mathbf{W_2}$
19.	*Agriotes sputator*	19	1.62	$\mathbf{D_2}$	20	$\mathbf{C_1}$	0.32	$\mathbf{W_2}$
20.	*Agriotes brevis*	2	0.17	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.10	$\mathbf{W_2}$
21.	*Agriotes obscurus*	7	0.60	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.36	$\mathbf{W_2}$
22.	*Dalopius marginatus*	18	1.53	$\mathbf{D_2}$	40	$\mathbf{C_2}$	0.61	$\mathbf{W_2}$
23.	*Synaptus filiformis*	14	1.19	$\mathbf{D_2}$	60	$\mathbf{C_3}$	0.72	$\mathbf{W_2}$
24.	*Adrastus rachifer*	2	0.17	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.07	$\mathbf{W_1}$
25.	*Adrastus limbatus*	2	0.17	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.07	$\mathbf{W_1}$
26.	*Dicronychus cinereus*	3	0.26	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.05	$\mathbf{W_1}$
27.	*Melanotus brunnipes*	5	0.43	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.17	$\mathbf{W_2}$
28.	*Melanotus rufipes*	4	0.34	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.20	$\mathbf{W_2}$
29.	*Melanotus castanipes*	6	0.51	$\mathbf{D_1}$	40	$\mathbf{C_2}$	0.20	$\mathbf{W_2}$
30.	*Melanotus tenebrosus*	2	0.17	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.03	$\mathbf{W_1}$
31.	*Melanotus crassicollis*	23	1.96	$\mathbf{D_2}$	60	$\mathbf{C_1}$	1.18	$\mathbf{W_3}$
32.	*Cidnopus pilosus*	91	7.76	$\mathbf{D_4}$	80	$\mathbf{C_4}$	6.21	$\mathbf{W_4}$
33.	*Notodes parvulus*	7	0.60	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.36	$\mathbf{W_2}$
34.	*Harminius undulatus*	1	0.09	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.02	$\mathbf{W_1}$
35.	*Hemicrepidius niger*	253	21.57	$\mathbf{D_5}$	100	$\mathbf{C_4}$	21.57	$\mathbf{W_5}$
36.	*Hemicrepidius hirtus*	25	2.13	$\mathbf{D_3}$	80	$\mathbf{C_4}$	1.71	$\mathbf{W_3}$
37.	*Crepidophorus mutilatus*	8	0.68	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.41	$\mathbf{W_2}$
38.	*Athous sacheri*	6	0.51	$\mathbf{D_1}$	30	$\mathbf{C_2}$	0.15	$\mathbf{W_2}$
39.	*Athous haemorrhoidalis*	28	2.39	$\mathbf{D_3}$	80	$\mathbf{C_4}$	1.91	$\mathbf{W_3}$
40.	*Athous vittatus*	4	0.34	$\mathbf{D_1}$	40	$\mathbf{C_3}$	0.14	$\mathbf{W_2}$
41.	*Athous subfuscus*	32	2.73	$\mathbf{D_3}$	80	$\mathbf{C_4}$	2.18	$\mathbf{W_3}$
42.	*Athous zebei*	11	0.94	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.19	$\mathbf{W_2}$
43.	*Athous mollis*	4	0.34	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.07	$\mathbf{W_1}$
44.	*Athous austriacus*	13	1.11	$\mathbf{D_2}$	80	$\mathbf{C_4}$	0.89	$\mathbf{W_2}$
45.	*Athous jejunus*	1	0.09	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.02	$\mathbf{W_1}$
46.	*Athous bicolor*	3	0.26	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.15	$\mathbf{W_2}$
47.	*Athous campyloides*	14	1.19	$\mathbf{D_2}$	60	$\mathbf{C_3}$	0.72	$\mathbf{W_2}$
48.	*Dima elateroides*	1	0.09	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.02	$\mathbf{W_1}$
49.	*Ctenicera heyeri*	11	0.94	$\mathbf{D_1}$	60	$\mathbf{C_3}$	0.56	$\mathbf{W_2}$
50.	*Ctenicera pectinicornis*	8	0.68	$\mathbf{D_1}$	20	$\mathbf{C_1}$	0.14	$\mathbf{W_2}$

Nr. crt	SPECIA	A	D		C		W	
51.	*Ctenicera cuprea*	180	15.35	**D_5**	80	**C_4**	12.28	**W_5**
52.	*Ctenicera virens*	2	0.17	**D_1**	20	**C_1**	0.03	**W_1**
53.	*Anostirus purpureus*	2	0.17	**D_1**	40	**C_2**	0.07	**W_1**
54.	*Actenicerus sjaelandicus*	3	0.26	**D_1**	40	**C_2**	0.10	**W_2**
55.	*Selatosomus amplicollis*	2	0.17	**D_1**	20	**C_1**	0.03	**W_1**
56.	*Selatosomus aeneus*	4	0.34	**D_1**	40	**C_2**	0.14	**W_2**
57.	*Selatosomus latus*	40	3.41	**D_3**	60	**C_3**	2.05	**W_3**
58.	*Clambus bipustulatus*	1	0.09	**D_1**	20	**C_1**	0.02	**W_1**
59.	*Denticolis linearis*	2	0.17	**D_1**	40	**C_2**	0.07	**W_1**
60.	*Prosternon tessellatum*	30	2.56	**D_2**	100	**C_4**	2.56	**W_3**
Total		1173						

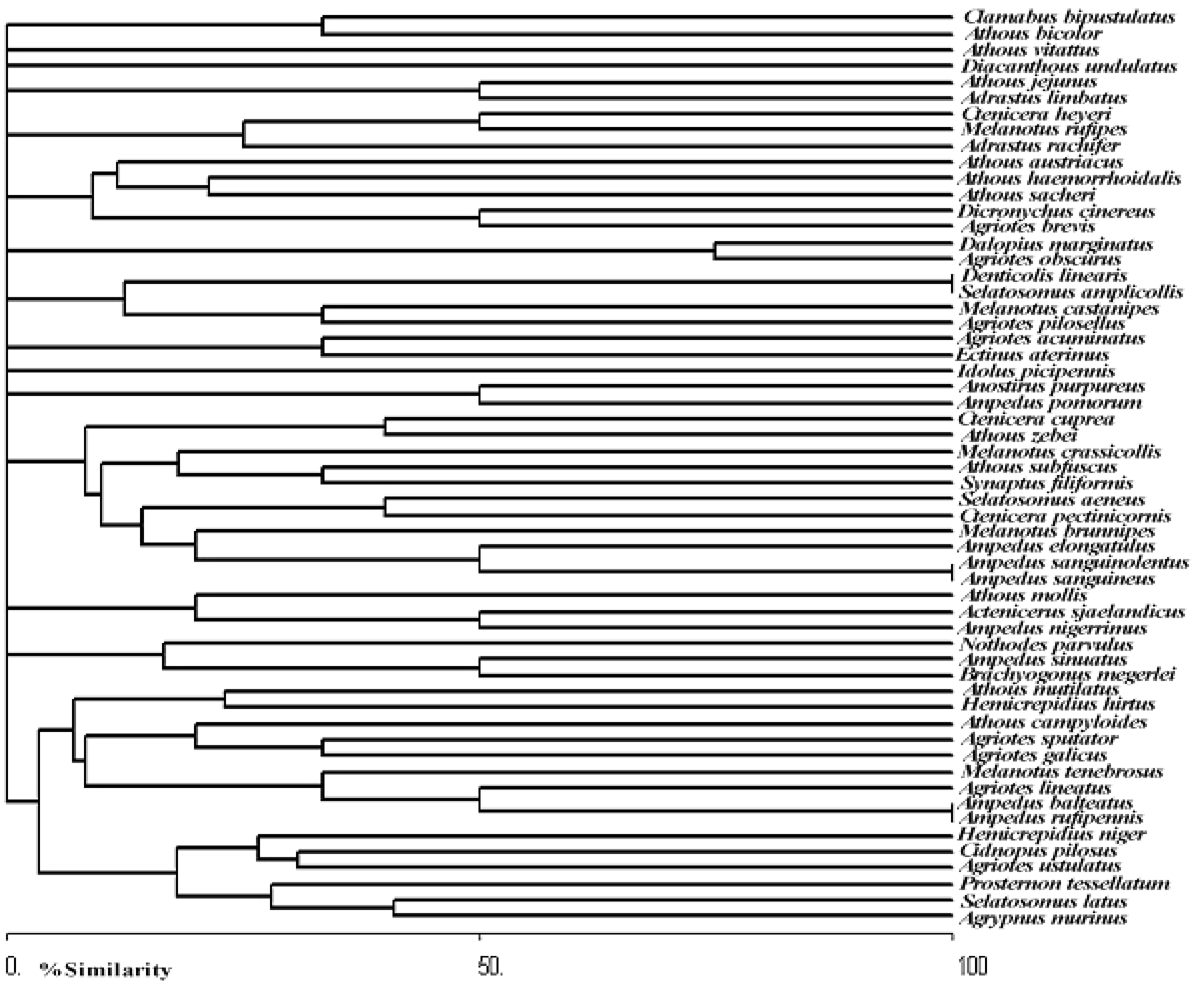

Figure 1 – The dendrogram of Elateridae species identified in grassland ecosystem

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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COCCINELIDE (*COLEOPTERA: COCCINELLIDAE*) FROM THE COLLECTIONS OF THE "ION BORCEA" MUSEUM COMPLEX OF NATURAL SCIENCES BACĂU

RODICA SERAFIM*, ARISTIŢA GOAGĂ**

ABSTRACT

SERAFIM R., GOAGĂ A., 2006 - Coccinelide (*Coleoptera: Coccinellidae*) from the collections of the "Ion Borcea" Museum Complex of Natural Sciences Bacău. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 299-303.

The paper presents a part of the Coccinelidae collection of the patrimony of "Ion Borcea" Museum Complex of Natural Sciences Bacău. From the studied material, 23 species of 17 genera, 6 tribes, 4 subfamilies were identified. They represent 37% of the total Romania Coccinelidae species.

Key words: Coleoptera, Coccinellidae, collections, "Ion Borcea" Museum Complex of Natural Sciences Bacău

Introduction

The Coccinellidae is an economically important family within Coleoptera. Some members are phytophagous pests, but many are beneficial predators and valuable biocontrol agents. The ladybirds are voracious predators feeding on aphids (greenfly), coccids (scale insects), mealybugs, whitefly and occasionally, on other insect pests of garden and crop plants, both larval and adult stages.

We are study a part of the *Coccinelidae* specimens from the entomologic patrimony of "Ion Borcea" Museum Complex of Natural Sciences Bacău

Material and methods

The material searched for this paper contains 2408 specimens collected between 1961–1999, from 100 collecting sites most of them from the counties of the Moldavian region: Bacău (most of them), Botoşani, Neamţ, Suceava, Vrancea and the also from Argeş, Braşov, Caraş-Severin, Covasna, Cluj, Constanţa, Mehedinţi, Prahova, Sălaj, Sibiu, Tulcea, and Mureş counties.

The material was identified by Rodica Serafim and Aristiţa Goagă. The complete revision of the identifications and also the nomenclature updating, presented in this paper, were made by Rodica Serafim.

The systematic presentation and nomenclature used in this paper are mostly according to those cited by CLAUDIO CANEPARI (2005) in Fauna Europaea.

Collecting data are chronologically presented. After the collecting sites, from other counties than Bacău, it is mentioned the abbreviation of the respective county, between brackets.

County abbreviation

AG - Argeş	CT – Constanţa	SB – Sibiu
BT - Botoşani	CV - Covasna	SJ - Sălaj
BV - Braşov	MH – Mehedinţi	SV - Suceava
CJ - Cluj	NT - Neamţ	TL – Tulcea
CS – Caraş-Severin	PH - Prahova	VN – Vrancea

Collectors' name abbreviation (legit):
A.V. – Astanei Valeria; C.C. – Chirilă C.; C.M. – Ciubotaru Maria; D.A. – Dima Aristiţa; F.F. – Feneru F.; G.A. – Goagă Aristiţa; H.M. – Hongu M.: M.E. – Mereuţă E.; N.V.- Nadolski V.; P.M. – Proca M.; P.O. – Pavel Otilia; P.V. - Pavel V.; P.E. – Păsălău Elena; R.C. – Rang Cătălin; R. – Răileanu; Ro.D. – Rotaru Dan; U.C. – Ureche C.
Mt/Mts. – mountain/s; spec./specs - specimen/s

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** "Ion Borcea" Natural Sciences Museum Complex, Aleea Parcului nr. 9, Bacău.

Subfamily **Scymninae**
Tribe **Scymnini**
Genus ***Scymnus*** Kugelann, 1794
Scymnus* (*Scymnus*) *frontalis (Fabricius, 1787)
1 spec. Piteşti (AG) 5.07.1962; 1 spec. Suceava (SV) 12.06.1967 R.

Subfamily **Chilochorinae**
Tribe **Chilocorini**
Genus ***Chilocorus*** Leach, 1815
Chilocorus bipustulatus (Linnaeus, 1758)
1 spec. Cernelele 21.07.1969; 1 spec. Perchiu 4.08.1992
Genus ***Exochomus*** Redtenbacher, 1843
Exochomus quadripustulatus (Linnaeus, 1758)
1 spec. Mangalia (CT) 4.08.1968 R.; 1 spec. Sărata (BC) 23.07.1971 G.A.; 1 spec. Băneasa (CT) 27.08.1991 D.A.
Exochomus nigromaculatus (Goeze, 1777)
1 spec. Băile Herculane (CS) 21.07.1968

Subfamily **COCCINELLINAE**
Tribe **Coccinellini**
Genus ***Adalia*** Mulsant, 1846
Adalia* (*Adalia*) *bipunctata (Linnaeus, 1758)
1 spec. Ocloş, Ciucului Mts 29.07.1966; 1 spec. Măleni 20.09.1969; 1 spec. Helegiu 30.09.1983 P.E.; 1 spec. Urecheşti 27.07.1984 D.A.; 2 specs Prăjeşti, Traian 11.06.1985 D.A.; 1 spec. Slănic Moldova 18.08.1991 P.E.; 1 spec. Fântânele 7.08.1992 D.A.; 1 spec. Perchiu 4.08.1992 Ro.; 1 spec. Dorofei 26.04.1994 D.A.; 4 specs Valea Uzului, Dărmăneşti 5.07.1994 D.A.
Adalia* (*Adalia*) *decempunctata (Linnaeus, 1758)
1 spec. Durău, Ceahlău Mts (NT) 18.06.1994 G.A.
Anatis Mulsant, 1846
Anatis ocellata (Linnaeus, 1758)
1 spec. Valea Uzului, Dărmăneşti 6.07.1994 H.M.; 1 spec. Hemeiuş 4.08.1994 H.M.; 1 spec. Bacău 19.08.1994 N.V.
Calvia Mulsant, 1846
Calvia decemguttata (Linnaeus, 1767)
1 spec. Ponoare 24.06.1968; 1 spec. Gorovei 5.07.1968; 1 spec. Slănic Moldova 11.06.1971 G.A.; 1 spec. Perchiu 27.07.1994 H.M.
Calvia quatuordecimguttata (Linnaeus, 1758)
1 spec. Ipoteşti (BT) 7.06.1968; 1 spec. Perchiu 12.05.1975 G.A.; 1 spec. Strugari 8.07.1983 G.A.; 16 spec. Prăjeşti, com. Traian 11.06.1985 G.A.
Genus ***Coccinella*** Linnaeus, 1758
Coccinella* (*Coccinella*) *quinquepunctata (Linnaeus, 1758)
2 spec. Racova 23.07.1985 D.A.; 2 spec. Secuieni 21.09.1983 P.E.
Coccinella* (*Coccinella*) *septempunctata (Linnaeus, 1758)
Suceava (SV) 1 spec. 27.04.1962, 3 specs 26.06.-28.08.1968; 2 specs Slătioara (SV?) 20.07.1964; 1 spec. Lespezi 1.08.1965; Bacău 1 spec. 3.05.1967 G.A., 11 specs 19-21.06.1974 G.A., 2 specs 10.06.1976 G.A., 19 specs 26.07.-4.08.1984 G.A., 1 spec. 26.07.1993 C.; 1 spec. Suceava, Burdujeni (SV) 30.06.1967; 1 spec. Ion Creangă (NT) 21.07.1967; Ponoare (SV) 6 specs 24.06.1968, 1 spec. 2.08.1970; 1 spec. Pătrăuţi (SV) 28.06.1968; 3 specs Brateş, Răchitiş (NT) 8.07.1968; Călimani Mts 1 spec. 30.08.1968, 1 spec. 30.08.1969, 1 spec. 16.07.1970; 1 spec. Gorovei (NT) 17.08.1969; Coţofăneşti 1 spec. 8.06.1970, 1 spec. 21.X.1983 P.E., 2 specs 4.08.-25.09.1984 G.A.; 1 spec. Letea, Danube Delta (TL) 30.07.1970 R.; 1 spec. Dofteana 11.05.1971 G.A.; 1 spec. Zboina (VN) 27.06.1971 G.A.; secular forest Runc, Ceahlău Mts (NT) 3 specs 14.07.1971 G.A., 33 specs 27-29.07.1994 G.A., 15 specs 4.08.1995; 19 specs Valea Frumoasei 5-15.07.1972 G.A.; Răchitoasa 9 specs 19-21.07.1972 G.A., 10 specs 23.07.1980 A.V.; 1 spec. Coman 4.08.1972 G.A.; Slănic Moldova 4 specs 5-6.09.1972 G.A., 3 specs 29.08.-17.X.1990 P.V., 3 specs 18.08.1991 P.E.; 3 specs Babadag (TL) 12-13.06.1973 G.A.; Valea Budului 1 spec. 17.07.1973 G.A., 8 specs 18.06.1994 P.E., 4 specs 28.08.1995 C.M., 15 specs 28.05.-6.08.1996 P.E., H.M., C.M., C.C., 2 specs 13.05.-17.06.1997 P.O., 1 spec. 13.05.1998 P.M., 2 specs 1.06.1999; 1 spec. Verşeşti 9.08.1973 G.A.; 4 specs Parava 29.08.1973 G.A.; Gura Văii 24 specs 7.06.1974 G.A., 75 specs 17.06.1975 G.A.; Racova 133 specs 7-31.05.1974 G.A., 8 specs 24.06.1974 G.A., 3 specs 11.06.1975 G.A., 1 spec. 8.06.1977 G.A., 60 specs 26-28.06.1979 G.A., 7 specs 24.06.-13.08.1980 P.E., A.V., 2 specs 4.07.1981, 2 specs 17.08.-16.09.1982 A.V., 2 specs 6.X.1983 P.E., 29 specs 5.06.-8.09.1986 G.A., P.E., 1 spec. 24.07.1990 G.A., 10 specs 7.08.1991 P.E., 1 spec. 5.06.1995 C.M.; 1 spec. Luncani 4.06.1974 G.A.; 1 spec. Nicolae Grigorescu 4.06.1974 G.A.; 16 specs Tarcău Mts, Tărhăuş, 26-28.06.1974 G.A., Brusturoasa 43 specs 19-20.06.1974 G.A., 3 specs 4.07.1978 G.A., 7 specs 17.05.1979 M.E., 3 specs 19.07.1989 D.A., 22 specs 27.07.1990 G.A., 5 specs 24-27.07.1991 Ro.D.; Hemeiuş 5 specs 15.07.-2.08.1974 G.A., 14 specs 16.06.1975 G.A., 10 specs 16.06.-14.07.1976 G.A., 18 specs 17-27.06.1977 A.V., G.A., 1 specs 2.07.1979 G.A., 2 specs 19.07.-16.08.1982 A.V., G.A., 4 specs 8.08.1985 G.A., 11 specs 22.07.1989 G.A., 8 specs 18-26.07.1990 G.A., 4 specs 28.07.-13.08.1994 H.M., 5 specs 30.05.-13.09.1995 C.M., 6 specs 18-20.06.1996 G.A., C.M.; Nicolae Bălcescu 1 specs 2.06.1975 G.A., 4 specs 6-9.07.1977 A.V., G.A.; Perchiu 1 spec. 12.05.1971 G.A., 1 spec. 16.08.1972 G.A., 3 specs 8-29.07.1976 G.A., 1 spec. 4.08.1992 R.D., 2 specs 27.07.1994 H.M.; 5 specs Balcani 28.07.1976 G.A.; 3 specs Traian 1.09.1976 G.A.; Valea Seacă 4 specs 18.06.-14.07.1977 A.V., 3 specs 21.06.1982 A.V.; Bacău, Gherăieşti 1 spec. 4.05.1967 G.A., 1 spec. 10.07.1971 G.A., 5 specs 11-

28.07.1972 G.A., 1 spec. 20.05.1974 G.A., 3 specs 7.06.1977 A.V., 2 specs 10-11.07.1978 G.A., 2 specs 21.08.1995 B.C., 8 specs 10.06.-13.08.1996 D.A., U.C., 16 specs 12.07.1999 P.M.; 9 specs Băile Herculane (CS) 1-2-06.1978 G.A.; 1 spec. Valea Siretului 4.08.1978 G.A.; 1 spec. Bătrâneşti (BT) 7.08.1978 G.A.; Trebiş, Mărgineni 1 spec. 1.06.1980 R.C., 3 specs 22.07.1993 H.M.; 19 specs Plopana 10.08.-24.09.1981 D.A., 1 spec. 1.06.1994 D.A.; Urecheşti 151 specs 17.07.-9.09.1981 G.A., 1 spec. 27.07.1984 G.A.; 3 specs Băile Covasna (CV) 29.05.-1.06.1982 G.A.; Sascut 1 spec. 13.09.1982 G.A., 1 spec. 23.09.1985 D.A., 5 specs 4.08.1986 D.A., 5 specs 4.08.1987 G.A.; 27 specs Strugari 8-20.07.1983 G.A.; 68 specs Secuieni 21.09.1983 P.E.; 18 specs Prăjeşti 11.06.-11.07.1985 D.A.; 3 specs Sărata 4.08.1986 P.E.; Fântânele 21 specs 18.07.1990 G.A., 8 specs 7.08.1992 G.A.; Dospineşti 5 specs 16.07.1983 P.E., 4 specs 20.07.1985 P.E., 1 spec. 28.06.1992 P.E.; 10 specs Măgura 23.07.1984 G.A.; 1 spec. Sinaia (PH) 7.09.1987 P.E.; 1 spec. Poiana Braşov (BV) 18.06.1990 P.E.; 16 specs Poduri 28.06.1990 G.A.; 1 spec. Hălmăcioaia 2.08.1990 P.E.; 5 specs Băneasa (Bucureşti) 20-26.08.1991 P.E.; 9 specs Valea Budului 18.06.1994 P.V.; Valea Uzului, Dărmăneşti 7 specs 12-13.07.1993 P.E., 9 specs 18.07.1994 P.E.; 2 specs Dorofei 16.05.1994; 14 specs Godovana 26.04.-15.05.1994 D.A., P.A.; 9 specs Izvorul Muntelui, Ceahlău Mts (NT) 14-18.07.1994 D.A., P.E.; 3 specs Bisericani (NT) 17.09.1994 D.A.; Buhoci 1 spec. 22.05.1995 C.M., 8 specs 22.05.1996 D.A.; 10 specs Şerbăneşti 27-29.04.1995 P.E., 15 specs 1.05.1995 D.A., P.E.; 16 specs Iteşti 10.05.1995 G.A., H.M., 3 specs 8-14.05.1997 P.E.; 4 specs Ceahlău (NT) 10.05.1995 D.A.; 7 specs Vânători (NT) 7.09.1995 D.A.; 11 specs Durău (NT) 11-13.09.1995 D.A., P.E.; Bibireşti 1 spec. 24.05.1996 D.A., 1 spec. 12.05.1997 C.M.; Luncani 1 spec. 3.07.1996 J.O., 1 spec. 29.06.1997 F.F.; 4 specs Liteni (SV) 16-19.07.1996 D.A.; 5 specs Băbuşana (VS) 7.06.1997 C.C.; 1 spec. Făget (CJ) 21.06.1998 H.M.

Coccinula Linnaeus, 1758

Coccinula quatuordecimpustulata (Linnaeus, 1758)

Suceava (SV) 1 spec. 19.05.1963, 3 specs Băile Herculane (CS) 3.07.1969; 1 spec. 8.06.1970 G.A.; 1 spec. Tălmaciu (Meghiş – SB) 19.08.1970 G.A.; 1 spec. Valea Frumoasei 15.07.1972 G.A.; 1 spec. Răchitoasa 19.07.1972 G.A.; 1 spec. Luizi Călugăra 3.08.1972 G.A.; 1 spec. Măgura 17.09.1976 G.A.; Racova 1 spec. 10.08.1978 G.A., 1 spec. 5.08.1991 G.A.; 2 specs secular forest Runc, Ceahlău Mts (NT) 28.06.1978 G.A.; 8 specs Hemeiuş 2.07.-6.08.1979 G.A.; 34 specs Urecheşti 17.07.-10.09.1981 D.A.; 1 spec. Brusturoasa 24.07.1981 D.A.; 10 specs Plopana 10.08.-24.09.1981 D.A.; 2 specs Sascut 22.07.-13.09.1982 D.A.; 7 specs Strugari 19.07.1983 D.A.; 1 spec. Coţofăneşti 4.08.1984 D.A.; 1 spec. Godovana, Dorofei 16.05.1994

Genus ***Oenopia*** Mulsant, 1850

(syn. *Synharmonia* Ganglbauer, 1899)

Oenopia conglobata (Linnaeus, 1758)

Racova 1 spec. 8.06.1977 G.A., 1 spec. 6.X.1983 P.E.; 1 spec. Prăjeşti, com. Traian 11.06.1981 G.A.; 1 spec. Strugari 8.07.1983 G.A.

Genus ***Propylaea*** Mulsant, 1846

Propylaea quatuordecimpunctata (Linnaeus, 1758)

Suceava (SV) 1 spec. 15.07.1961, 2 spec. 2-4.08.1962, 1 spec. 28.04.1962, 1 spec. 11.05.1969; 1 spec. Rotunda (SV) 5.06.1962; 1 spec. Piteşti (AG) 5.07.1962; 1 spec. Corocăieşti (SV) 13.07.1962; 2 specs Ponoare 17.05.1968; 1 spec. Câmpulung Moldovenesc 27.06.1968; Coţofăneşti 1 spec. 8.06.1970 G.A., 2 specs 30.08.1984 G.A.; Bacău, Măgura 1 spec. 11.07.1970, 1 spec. 11.08.1976 G.A., 1 spec. 23.07.1984 G.A.; Urecheşti 2 specs 10-16.06.1970 G.A., 2 specs 10.09.1981 G.A., 1 spec. 11.08.1981 G.A., 3 specs 17.07.1981 G.A.; Dofteanca 1 spec. 11.05.1971 G.A., 1 spec. 8.07.1971 G.A.; 8 specs Valea Frumoasei 13-15.07.1972 G.A.; 2 specs Coman 26.05.-4.08.1972 G.A.; 3 specs Scorţeni 21.06.1973 G.A.; Racova 4 specs 31.05.1974 G.A., 2 specs 7-24.06.1974 G.A., 8 specs 11.06.1975 G.A., 3 specs 5-8.07.1977 G.A., 24 specs 26-28.06.1979 G.A., 4 specs 24.06.-29.08.1980 D.A., 6 specs 5-14.08.1981 G.A.; 1 spec. Luncani, Bacău 4.06.1974 G.A.; Fântânele 4 specs 24.06.1975 G.A., 2 specs 18.07.1990 G.A., 1 spec. 7.08.1992 D.A.; Hemeiuş 1 spec. 2.08.1974 G.A., 3 specs 16.06.1975 G.A., 4 specs 17.06.1977 G.A., 3 specs 10.07.1978 G.A., 42 specs 25.05. – 7.08.1979 G.A., 1 spec. 7.08.1981 G.A., 2 specs 16.08.1982 G.A.; 1 spec. Balcani 28.07.1976 G.A.; 4 specs Nicolae Bălcescu 1.07.1977 G.A.; 2 specs Valea Seacă 8.07.1977 G.A.; 1 spec. Hinova (MH) 30.07.1978 G.A.; Plopana 2 specs 10.08.1981 G.A., 1 spec. 1.06.1994 P.E.; 1 spec. Helegiu 30.09.1983 P.E.; 5 specs Strugari 8-20.07.1983 D.A.; 2 specs Bacău 4.08.1984 G.A.; 4 specs Dospineşti 20.07.1985 D.A.; 2 specs Valea Uzului, Dărmăneşti 5-10.07.1994 G.A.; 3 specs Izvorul Muntelui, Ceahlău Mts (NT) 18.07.1994 G.A., P.E.; 1 spec. Godovana, Dorofei 16.05.1994; 2 specs secular forest Runc, Ceahlău Mts (NT) 29.07.1994 G.A.; 4 specs Iteşti 10.05.1995 P.E., H.M.

Genus ***Tytthaspis*** Crotch, 1874

Tytthaspis sedecimpunctata (Linnaeus, 1758)

4 specs Comarova forest, Mangalia (CT) 2.08.1968; 4 specs Hemeiuş 25.06.-3.08.1979 G.A.; 75 specs Sascut 10-13.09.1982 D.A.

Tribe **Hippodamiini** Mulsant, 1846

Genus ***Adonia*** Mulsant, 1846

Adonia variegata (Goeze, 1777)

1 spec. Vârciorova (CS) 3.07.1967; 2 specs Comarova forest, Mangalia 2/4.08.1968; 1 spec. Hagieni forest, Limanu (CT) 11.08.1968; 1 spec. Adamclisi 13.07.1970; 2 specs Maliuc, Danube Delta (TL) 10.07.1971; 5 specs Valea Frumoasei 13-15.07.1972 G.A.; 1 spec. Răchitoasa 20.07.1972 G.A.; 1 spec. Coman 4.08.1972 G.A.; 1 spec. Bijchir 10.08.1972 G.A.; 1 spec. Luizi Călugăra 3.08.1973 G.A.; 1 spec. Gherăieşti forest, Bacău 19.07.1975; Racova 2 specs 26.06.1979 G.A., 1 spec. 24.06.1980, 3 specs 5.08.-7.09.1981 G.A., A.V., 10 specs 6.X.1983 P.E., 3 specs 8.09.1986 G.A.; Hemeiuş 7 specs 2.07.-6.08.1979 G.A., 2 specs 25.08.1982 G.A., 1 spec. 3.08.1985 G.A., 2 specs 22.07.-18.08.1989 G.A.; 9 specs Plopana 10.08.-24.09.1981 G.A.; Urecheşti 46 specs 17.07.-10.09.1981 G.A., 1 spec. 27.07.1984 D.A.; 25 specs Strugari 8-20.07.1983 D.A.; 290 specs Secuieni 21.09.1983 P.E.; 6 specs Helegiu 30.09.1983 P.E.; 17 specs Coţofeneşti 30.08.1984 D.A.; Sascut 19 specs 25.09.1984 D.A., 2 specs 23.09.1985 D.A., 2 specs 30.06.1988 D.A.; 4 specs Bacău 3.09.1985 P.E.; 14 specs Prăjeşti, Traian 11.06.1985 D.A.; 9 specs Dospineşti 20.07.1985 P.E.; 7 specs Sărata 4.08.1986 D.A., P.E.; Brusturoasa 4 specs 19.07.1989 D.A., 1 spec. 27.07.1991 P.E.; 1 spec. Poduri 22.06.1990 D.A.; 2 specs Valea Uzului, Dărmăneşti 5-7.07.1994 D.A.; 2 specs Izvorul Muntelui, Ceahlău Mts (NT) 18.07.1994 D.A.; 2 specs Runc chalet, Ceahlău Mts (NT) 29.07.1994 D.A.

Genus ***Anisosticta*** Dejean, 1835

Anisosticta novemdecimpunctata (Linnaeus, 1758)

1 spec. Iteşti 10.05.1995 P.E.

Genus ***Hippodamia*** Dejean, 1835

Hippodamia tredecimpunctata (Linnaeus, 1758)

1 spec. Ilişeşti (SV) 14.06.1963; 1 spec. Ponoare 24.06.1968; 3 specs Valea Frumoasei 5 – 14.07.1972 G.A.; 1 spec. Gura Văii 17.08.1975 G.A.; 1 spec. Bacău, Gherăieşti 19.06.1975; 1 spec. Hemeiuş 6.08.1979 G.A; 3 specs Urecheşti 17.07.1981 D.A.; 1 spec. Racova 14.08.1981 D.A.; 3 specs Secuieni 21.09.1983 P.E.; 1 spec. Bacău 22.07.1992

Hippodamia (***Semiadalia***) ***notata*** (Laicharting, 1781)

2 specs Valea Uzului, Dărmăneşti 12.07.1993 P.E.

Hippodamia (***Semiadalia***) ***undecimnotata*** (Schneider, 1792)

Perchiu 1 spec. 12.05.1971 G.A., 1 spec. 17.08.1976 G.A.; Hemeiuş 3 specs 16.06.1975 G.A., 2 specs 7–17.06.1977 G.A., 2 specs 28.07.–4.08.1994 H.; 1 spec. Bacău, Gherăieşti 10.06.1977 G.A.;1 spec. Băile Herculane (CS) 1.06.1978 G.A.; 1 spec. Nicolae Bălcescu 19.07.1979 G.A.; Racova 1 spec. 27.06.1979, 2 specs 8.09.1986 G.A.; 2 specs Urecheşti 11.08.–10.09.1981 G.A.; Bacău 2 spec. 4.08.1984 G.A., 1 spec. 8.09.1986 G.A.; 2 specs Coţofăneşti 30.08.1984 D.A.; 2 specs Prăjeşti, Traian 11.06.1985 G.A.; 1 spec. Sinaia 7.09.1987 P.; 4 specs Poduri 28.06.1990 G.A.; Fântânele 1 spec. 18.07.1990 G.A., 1 spec. 7.08.1992 G.A.; 7 specs Valea Uzului, Dărmăneşti 5 - 7.07.1994 D.A.; 1 spec. Izvorul Muntelui, Ceahlău Mts (NT) 18.07.1994 P.; 4 specs secular forest Runc, Ceahlău Mts (NT) 29.07.1994 D.A.

Tribe **Psylloborini** Casey, 1899

Genus ***Halyzia*** Mulsant, 1846

Halyzia sedecimguttata (Linnaeus, 1758)

2 specs Ponoare 24.06.1968

Subfamily **EPILACHNINAE**, Mulsant, 1846

Tribe **Madaini** Gordon, 1975

Genus ***Cynegetis*** Redtenbacher, 1843

Cynegetis impunctata (Linnaeus, 1767)

2 specs Hemeiuş 22.07.1989 D.A.

Genus ***Subcoccinella*** Guérin – Ménéville, 1842

Subcoccinella vigintiquatuorpunctata (Linnaeus, 1758)

1 spec. Grigoreni, com. Scorţeni 9.06.1967 G.A.; Hemeiuş 2 specs 11.07.1971, 6 spec. 2.07. - 6.08.1979 G.A.; 9 specs Valea Frumoasei 14 – 15.07.1972 G.A.; 23 specs Valea Seacă, Nicolae Bălcescu 1 - 26.07.1977 G.A., 1 spec. 19.07.1979 G.A.; 12 specs Urecheşti 17.07.1981 – 27.07.1984 D.A.; 1 spec. Megheş 19.08.1970 G.A.; 1 spec. Pietricica (NT) 11.05.1971 G.A.; 1 spec. Maliuc, Danube Delta (TL) 10.07.1971 R. ; 1 spec. Botoşani 30.07.1971; 1 spec. Scorţeni 21.06.1972 G.A.; 1 spec. Babadag, Danube Delta (TL) 14.06.1973 G.A.; 1 spec. Bacău 10.06.1976 G.A.; 1 spec. Filipeşti 31.08.1977 G.A.; 1 spec. Odobeşti, Secuieni 18.07.1977 G.A.; 1 spec. Racova 14.08.1981 D.A.; 1 spec. Brusturoasa 27.08.1991 P.E.; 1 spec. Lunca 29.07.1994 D.A.

Results and discussions

In the studied material 23 species of 17 genera, 6 tribes, and 4 subfamilies were identified.

The subfamily Coccinellinae, with 17 species, is best represented. The subfamily Chilocorinae is represented by three species, the subfamily Epilachninae by two species and the subfamily Scymninae by one species.

Some of the most known predator species, aphidophagous as: *Adalia*, *Adonia*, *Anisosticta*, *Calvia*, *Coccinella*, *Coccinula*, *Hippodamia*, *Propylaea* are preserved in the collection.

The commonest species, the two-spot ladybird (*Adalia bipunctata*) and the seven-spot ladybird (*Coccinella septempunctata*) are well represented in collections.

Anatis ocellata (eyed ladybird), the largest species, is almost always found in coniferous forests and plantations. The eyed ladybird feeds on aphids (Lachnidae), *Chrysomela* and Tortricidae larvae.

Anisosticta novemdecimpunctata (water ladybird) has a neatly preference for humid biotopes, being hosted on aquatic plants preferably on *Phragmites* and *Typha*, seldom on *Acorus*, *Iris*, *Sparganium*, *Eleocharis palustris*. Sometimes it is occurred in association with *Hippodamia tredecimpunctata* (thirteen-spot ladybird) which has the same preferences, being occurred on *Phragmites*, *Typha*, *Carex*, *Sparganium*, *Salix*. These species feed on aphids from the plants, especially *Hyalopterus pruni*.

The species from the tribe Chilocorini: *Chilocorus bipustulatus*, *Exochomus quadripustulatus* and *E. nigromaculatus* eat scale insects (Coccids).

Calvia quatuordecimguttata is an polifagous species (food: psyllids, aphids, Chrysomelidae larvae, leafhoppers).

The orange ladybird (*Halyzia sedecimguttata*) is mycetophagous, like other species from the tribe Psylloborini, and lives on the mildews on the leaves of various trees.

The phytophagous species, *Subcoccinella vigintiquatuorpunctata* (twenty-four-spot ladybird) attack different grassy plants like: *Medicago sativa*, *Silene dioica*, *Cirisum* sp., *Lactuca* sp.

References

1. CANEPARI C., 2005 - Familia Coccinellidae. *In*: Fauna Europaea. Site Internet: www.faunaeur.org.
2. FÜRSCH H., 1967. Familia Coccinellidae. *In*: Die Käfer Mitteleuropa, **7**: 227–278.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE CERAMBICIDS COLLECTION CATALOGUE (COLEOPTERA, CERAMBYCIDAE) FROM THE PATRIMONY OF „ION BORCEA" NATURAL SCIENCES MUSEUM COMPLEX OF BACĂU

GURĂU GABRIELA, CIUBOTARU MARIA*

ABSTRACT

GURĂU G., CIUBOTARU M., The Cerambicids Collection Catalogue (Coleoptera, Cerambycidae) from the patrimony of „Ion Borcea" Natural Sciences Museum Complex of Bacău, *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 304-348.

The paper presents collections of cerambicids of „Ion Borcea" Natural Sciences Museum of Bacău. The cerambicids were collected from 159 locations, between 1969 and 2005. In the colletions of our museum Cerambycidae family is represented by 3986 individuals from 97 species.

Keywords: Coleoptera, Cerambycidae, „Ion Borcea" Natural Sciences Museum of Bacău

Introduction

Natural Sciences Museums are the treasurers of our national natural patrimony. In the process of studying biodiversity the collections are basic components.

The entomologic collections of *„Ion Borcea" Natural Sciences Museum of Bacău* comprise over 50.000 specimens. The cerambicids (3986 specimens – 97 species) were collected by our specialists during scientific expeditions made in 157 localities between 1969 – 2005.

The cerambicids were identified by Răileanu G., Serafim Rodica and since 1998 by Gurău Gabriela. The species identified by Răileanu G. and Serafim Rodica were reidentified by Gurău Gabriela.

Material and methods

The material presented in this paper contains 3986 specimens, collected between 1969 – 2005 from 157 localities. The systematic order and nomenclature used in this paper are acording to those published by Danilevsky L. M. in *„Systematic list of longhorn beetles (Cerambycoidea, Coleoptera) of Europe"*(2003).

The species are presented in systematic order, and for each species are presented the number of specimens, collecting sites, collecting data, the initials of the persons who collected, preserved and identified the specimens and the total number of specimens. The data for each species are presented in a table, in chronological order.

The paper presents the collectors names and their abreviations (table. no. 1) and the collection sites (with counties) (table no.2).

The cerambicids were identified by Răileanu G., Serafim Rodica and since 1998 by Gurău Gabriela.

The collecting sites and the collectors' names are alphabetically ordered. In table no.3 we present the taxonomic classification of the species and the number of identified specimens.

Table no.1 The collectors names and the used abreviations.

A.V. - Astanei Valeria = Pavel Valeria	F. F. - Feneru Florin	P. C. – Paragină Carla
B. C. – Burghelea Costel	G.A. - Goagă Aristiţa	P. E. – Păsălău Elena
B. D. - Boghiu Dana	G. G. - Gurău Gabriela	P. M. – Proca Maria
C. G. - Codreanu Gabriela	G. O. - Goagă Ovidia	P. O. – Pavel Otilia
C. C. - Chirilă Constantin	H. M. - Hongu Maria	P. V. – Pavel Valeria
C. L. - Ciucă Lăcrămioara = Zaharia Lăcrămioara	J. O. – Jigău Ortansa	R. C. – Rang Cătălin
C. M. - Ciubotaru Maria	L. S. – Laslău Silvia	R.G. – Răileanu G.
D. L. - Doroftei Liliana	M. A. – Merluşcă Alina	T. B. – Tomozei Bogdan
	M. C. – Marcoci Corina	U. C. – Ursache Claudia
	M.D. – Maftei Daniel	

* "Ion Borcea" Natural Sciences Museum Complex, Bacău

Table no.2 The list of collecting sites.

1. Adâncata IȘ
2. Adâncata SV
3. Agapia NT
4. Agigea CT
5. Apa Roşie BC
6. Arama IS
7. Babadag TL
8. Bacău BC
9. Balcani BC
10. Barați BC
11. Başta NT
12. Băbuşa VS
13. Băile Herculane CS
14. Bălătău BC
15. Bălăneşti BC
16. Băneasa NT
17. Bereşti Tazlău BC
18. BerzuNTi BC
19. Bibireşti BC
20. Bijghir BC
21. Bistrița BN
22. Bogdan Vodă BC
23. Borsec HG
24. Botoşani BT
25. Brusturoasa BC
26. Buhoci BC
27. Buhuşi BC
28. Burdujeni IS
29. Câmpulung SV
30. Caşin BC
31. Caşin (ÎNTărcătoarea) BC
32. Căiuți BC
33. Călimani HG
34. Călugăra BC
35. Ceahlău NT
36. Cheile Bicazului NT
37. Cheile Turzii CJ
38. Chiril SV
39. Colibaba SV
40. Comarova CT
41. Corocăieşti SV
42. Cotuşca BT
43. Coțofăneşti BC
44. Covasna CV
45. D.Runcului BC
46. Dămieneşti BC
47. Dofteana BC
48. Dorohoi SV
49. Dospineşti BC
50. Durău NT
51. Fântânele BC
52. Făget CJ
53. Fălticeni SV
54. Feteşti CT
55. Filipeni BC
56. Gârboavele BC
57. Găiceana BC
58. Gh. Gh. Dej BC
59. Gherăieşti BC
60. Gioseni BC
61. Glodişoare BC
62. Gloduri BC
63. Godovana BC
64. Gorgova TL
65. Gorovei BT
66. Gorovei SV
67. Gura Bărzăuței BC
68. Gura Văii BC
69. Hemeiuşi BC
70. Holt BC
71. Humărie BC
72. Iaşi IS
73. Istria CT
74. Ițcani SV
75. Izvorul Alb BC
76. Lacul Sinoe CT
77. Lacul Roşu NT
78. Liteni BC
79. Luncani BC
80. M.Caşin BC
81. Măgura BC
82. Mărăşti BC
83. Mărăşti VN
84. Mărgineni BC
85. Meghiş SB
86. Moghioroş BC
87. M-ții Cocoşul
88. Nemira BC
89. Nemțişor NT
90. Obcioara SV
91. Ocloş V.Uz. BC
92. Onceşti BC
93. Oneşti BC
94. Onişcani BC
95. Oradea BH
96. Orăşeni HG
97. Orbeni BC
98. Poiana Sărată BC
99. Poiana Stampei SV
100. Perchiu BC
101. Piatra Craiului BV
102. Pietricica BC
103. Piteşti AG
104. Plopana BC
105. Poduri BC
106. Ponoare MH
107. Prăjeşti BC
108. Prinosu Mare SV
109. Racova BC
110. Rarău NT
111. Răcăciuni BC
112. Răchitoasa BC
113. Rodna BN
114. Roman NT
115. Rotunda SV
116. Runc BC
117. Runc NT
118. Sânpetru Mare TM
119. Sascut BC
120. Sărărie BC
121. Scutaru BC
122. Sinaia BV
123. Slănic Moldova BC
124. Slănic Prahova PH
125. Slănicel BC
126. Slătioara SV
127. Sohodol BC
128. Sohodol NT
129. Suceava SV
130. Sulina TL
131. Şandru BC
132. Tazlău BC
133. Tescani BC
134. Tg. Ocna BC
135. Tociloasa BC
136. Todireni SV
137. Turnu Severin CS
138. Traian BC
139. Trebeş BC
140. Udeşti SV
141. Urecheşti BC
142. Valea Bistriței SV
143. Valea Budului BC
144. Valea Colbu SV
145. Valea Frumoasei BC
146. Valea Uscată HG
147. Valea Uzului BC
148. Vânători NT
149. Vârciorova CS
150. Vaslui VS
151. Vatra Dornei SV
152. Văratec NT
153. Vereşti SV
154. Zărneşti BC
155. Zboina BC
156. Zeletin BC
157. Zugreni SV

Table no.3 Species of cerambicids from the collections of Natural Sciences Museum of Bacau - Taxonomic calssification.

No.	Subfamily	Tribe	Genera/Species	Number of specimens
1.	**Prioninae**	Prionini	*Prionus coriarius*	**29**
2.		Aegosomatini	*Aegosoma scabricornis*	**15**
3.	**Lepturinae**	Oxymirini	*Oxymirus cursor*	**2**
4.		Xylosteini	*Xylosteus spinolae*	**1**
5.		Rhagiini	*Rhagium inquisitor*	**1**
6.			*Rhagium mordax*	**10**
7.			*Rhagium sycophanta*	**12**
8.			*Stenocorus meridianus*	**2**
9.			*Pachyta quadrimaculata*	**93**
10.			*Dinoptera collaris*	**38**
11.			*Carilia virginea*	**262**
12.			*Pidonia lurida*	**54**
13.		Lepturini	*Gramoptera ruficornis*	**1**
14.			*Alosterna tabacicolor*	**5**
15.			*Pseudovadonia livida*	**133**
16.			*Vadonia steveni*	**5**
17.			*Anoplodera sexguttata*	**2**
18.			*Anoplodera rufipes*	**2**
19.			*Lepturobosca virens*	**44**
20.			*Aredolpona rubra*	**296**
21.			*Paracorymbia erythroptera*	**1**
22.			*Paracorymbia maculicornis*	**67**
23.			*Paracorymbia scutellata*	**202**
24.			*Anastrangalia sanguinolenta*	**33**
25.			*Anastrangalia dubia*	**19**
26.			*Judolia sexmaculata*	**4**
27.			*Pachytodes cerambyciformis*	**248**
28.			*Pachytodes erraticus*	**29**
29.			*Leptura quadrifasciata*	**94**
30.			*Leptura aurulenta*	**9**
31.			*Leptura annularis*	**70**
32.			*Leptura aethoips*	**1**
33.			*Rutpela maculata*	**1192**
34.			*Stenurella melanura*	**149**
35.			*Stenurella bifasciata*	**33**
36.			*Stenurella nigra*	**26**
37.			*Stenurella septempunctata*	**32**
38.			*Pedostrangalia pubescens*	**8**
39.			*Strangalia attenuata*	**12**
40.	**Necydalinae**		*Necydalis ulmi*	**1**
41.	**Spondylinae**	Asemini	*Arhopalus rusticus*	**3**
42.			*Tetropium castaneum*	**2**
43.			*Tetropium fuscum*	**1**
44.			*Spondylis buprestoides*	**2**
45.	**Cerambycinae**	Graciliini	*Axinopalpis gracilis*	**3**
46.		Molorchini	*Molorchus minor*	**1**
47.		Stenopterini	*Stenopterus flavicornis*	**2**
48.			*Stenopterus rufus*	**16**
49.		Cerambycini	*Cerambyx cerdo*	**6**
50.			*Cerambyx nodulosus*	**1**

51.			*Cerambyx scopolii*	**33**
52.		Purpuricenini	*Purpuricenus kaechleri*	**6**
53.			*Purpuricenus budensis*	**1**
54.		Callichromini	*Aromia moschata*	**7**
55.		Rosaliini	*Rosalia alpina*	**48**
56.		Hylotrupini	*Hylotrupes bajulus*	**8**
57.		Callidiini	*Rhopalopus clavipes*	**2**
58.			*Rhopalopus macropus*	**4**
59.			*Callidium violaceum*	**8**
60.			*Callidium aenea*	**2**
61.			*Phymatodes testaceus*	**7**
62.		Anaglyptini	*Anaglyptus mysticus.*	**2**
63.		Clytini	*Plagionotus arcuatus*	**9**
64.			*Echinocerus floralis*	**10**
65.			*Isotomus speciosus*	**2**
66.			*Chlorophorus herbsti*	**1**
67.			*Chlorophorus varius*	**55**
68.			*Chlorophorus figuratus*	**12**
69.			*Chlorophorus sartor*	**33**
70.			*Cyrtoclytus capra*	**18**
71.			*Clytus arietis*	**6**
72.			*Clytus lama*	**1**
73.			*Clytus rhamni*	**4**
74.	**Lamiinae**	Mesosini	*Mesosa curculionoides*	**3**
75.			*Mesosa nebulosa*	**1**
76.		Monochamini	*Monochamus sartor*	**7**
77.			*Morimus asper funereus*	**18**
78.		Lamiini	*Lamia textor*	**15**
79.		Dorcadionini	*Nedorcadion bilineatum*	**50**
80.			*Dorcadion fulvum*	**57**
81.			*Dorcadion pedestre*	**161**
82.			*Dorcadion murrayi*	**2**
83.			*Dorcadion holosericeum*	**5**
84.			*Dorcadion equestre*	**1**
85.			*Dorcadion scopoli*	**2**
86.		Acanthocini	*Leiopus nebulosus*	**4**
87.		Tetropini	*Tetrops praeustus*	**2**
88.		Saperdini	*Saperda scalaris*	**3**
89.			*Saperda populnea*	**1**
90.		Phytoeciini	*Oberea oculata*	**2**
91.			*Phytoecia nigripes*	**4**
92.			*Phytoecia pustulata*	**1**
93.			*Phytoecia coerulescens*	**1**
94.			*Agapanthia dahli*	**1**
95.			*Agapanthia villossoviridescens*	**79**
96.			*Agapanthia violacea*	**12**
97.			*Agapanthia leucaspis*	**1**
TOTAL				**3986**

I. Subfamily Prioninae
Tribe Prionini
Genera Prionus Geoffroy 1762
1. Prionus coriarius Linne 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Băneasa NT	11.07.1969	R. G.	R. G.	R. G.
1	Răchitoasa BC	14.07.1972	G. A.	G. A.	
1	Răchitoasa BC	21.07.1972	G. A.	G. A.	
1	Vatra Dornei SV	24.08.1972	R. G.	R. G.	
1	Dospineşti BC	02.08.1973	G. A.	G. A.	
1	Coțofăneşti BC	04.08.1984	G. A.	G. A.	
1	Valea Uzului BC	07.07.1994	P. E.	P.E.	
1	Valea Uzului BC	08.07.1994	C. G.	C. G.	
1	Valea Uzului BC	06.06.1996	H. M.	H. M.	
1	Valea Uzului BC	08.06.1996	C. G.	C. G.	
1	Izvorul Alb BC	24.07.1998	P.M.	G.O	G. G.
1	Izvorul Alb BC	22.07.1999	G. G.	G. G.	
1	Izvorul Alb BC	24.07.1999	H. M.	G. G.	
1	Izvorul Alb BC	24.07.1999	M. C.	G. G.	
1	Izvorul Alb BC	24.07.1999	G. G.	G. G.	
2	Urecheşti BC	1.09.1999	T. B.	G. G.	
7	Nemțişor NT	11.07.2000	T. B.	G. G.	
2	Vânători NT	12.08.2000	G. A.	G. A.	
1	Vânători NT	27.07.2000	C. M.	C. M	
1	Poiana Sărată BC	25.07.2001	P.M.	P.M.	
1	Vânători NT	03.08.2001	G. G.	G. G.	
29	Total				

Tribe Aegosomatini
Genera Aegosoma Audinet-Serville 1832
2. Aegosoma scabricornis Scopoli 1763

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Gherăieşti BC	08.07.1959	R. G.	R. G.	R. G.
1	Sohodol BC	12.08.1961	G. A.	G. A.	
1	Sulina TL	19.07.1967	R. G.	R. G.	
1	Turnu Severin CS	30.07.1973	G. A.	G. A.	
1	Oradea BH	06.06.1976	R. G.	R. G.	
1	Văratec NT	27.07. 1989	G. A.	G. A.	
1	Orbeni BC	24.04.1992	C.A.	C.A.	
1	Bacău BC	19.07.1993	P. E.	P.E.	S. R.
1	Bacău BC	21.07.1993	H. M.	H. M.	
1	Bacău BC	26.07.1993	P. E.	P.E.	
3	Agigea CT	24.07.2001	T. B.	T. B.	G. G.
1	Bacău BC	15.07.2002	H.M.	H.M.	
1	Bacău BC	26.07.2006	G. G.	G. G.	
15	Total				

Subfamily Lepturinae
Tribe Oxymirini Danilevsky 1997
Genera Oxymirus Mulsant 1863
3. Oxymirus cursor Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Piatra Craiului BV	6.06.2001	C. M.	P.M.	G.G.
1	Suceava SV	25.06.2003	B.G.	G.G.	
2	Total				

Tribe Xylosteini
Genera Xylosteus Frivaldsky 1838
4. Xylosteus spinolae Frivaldsky 1838

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Piatra Craiului BV	28.06.2001	G.D.	G.O.	G.G.
1	Total				

Tribe Rhagiini
Genera Rhagium Fabricius 1775
Subgenera Rhagium Fabricius 1775
5. Rhagium inquisitor Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Şandru BC	16.07.1970	G. A.	G. A.	S. R.
1	Total				

Subgenera Megarhagium Reitter 1912
6. Rhagium mordax Degeer 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Bacău BC	06.07.1978	G. A.	G. A.	S. R.
1	Bijghir BC	18.05.1979	G. A.	G. A.	S. R.
1	Valea Uzului BC	7.07.1996	C.M.	C.M.	G.G.
1	Valea Budului BC	15.05.2000	P.E.	P.E.	
1	Sărărie BC	23.06.2000	P.E.	G.O.	
1	Dofteana BC	24.06.2000	G.G.	G.G.	
2	Sărărie BC	28.06.2001	G.G.	H.M.	
1	Sărărie BC	26.06.2003	C.M.	C.M.	
1	Poiana Sărată BC	23.07.2003	G.G.	G.G.	
10	Total				

7. Rhagium sycophanta Schrk.

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Ceahlău NT	14.05.1959	R.G.	R.G.	S. R.
1	Godovana	16.05.1994	P.E.	P.E.	
1	Valea Budului BC	17.06.1997	P.V.	H.M.	G.G.
1	Valea Budului BC	10.06.2000	C. L.	H.M.	
1	Căiuți BC	19.05.2001	C. L.	P.M.	
3	Căiuți BC	7.05.2003	C.L.	G.G.	

1	Luncani BC	21.05.2003	R.S.	R.S.	
1	Luncani BC	22.05.2003	R.S.	H.M.	
1	Gherăieşti BC	25.05.2003	H.M.	H.M.	
1	Roman NT	13.08.2003	A.M.	G.G.	
12	Total				

Genera Stenocorus Geoffroy 1762
Subgenera Stenocorus Geoffroy 1762
8. Stenocorus meridianus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Rotunda SV	05.06.1962	R. G.	R. G.	R. G.
1	Arama SV	05.08.1969	R. G.	R. G.	R. G.
2	Total				

Genera Pachyta Dejean 1821
9. Pachyta quadrimaculata Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Chiril SV	01.08.1967	R. G.	R. G.	R. G.
2	Rarău NT	11.08.1970	R. G.	R. G.	R. G.
2	Tazlău BC	08.08.1973	G. A.	G. A.	G.G.
1	Valea Uzului BC	16.07.1993	C. M.	C. M	
1	Valea Uzului BC	07.07.1994	P. E.	P. E.	
2	Valea Uzului BC	08.07.1994	P. E.	P. E.	
1	Valea Uzului BC	08.07.1994	H. M.	H. M.	
1	Valea Uzului BC	08.07.1994	C. G.	C. G.	
1	Valea Uzului BC	08.07.1995	P. V.	C. G.	
2	Valea Uzului BC	16.07.1995	H. M.	H. M.	
4	Valea Uzului BC	16.07.1995	P. E.	P. E.	
1	Valea Uzului BC	16.07.1995	G. A.	G. A.	
3	Valea Uzului BC	16.07.1995	C. M.	C. M	
2	Valea Uzului BC	17.07.1995	H. M.	H. M.	
3	Valea Uzului BC	17.07.1995	C. M.	C. M	
1	Valea Uzului BC	18.07.1995	C. M.	C. M	
2	Valea Uzului BC	19.07.1995	H. M.	H. M.	
1	Valea Uzului BC	19.07.1995	C. M.	C. M	
1	Valea Uzului BC	19.07.1995	P. E.	P. E.	
1	Runc BC	04.08.1995	H. M.	H. M.	
1	Valea Uzului BC	17.08.1995	H. M.	H. M.	
1	Valea Uzului	7.06.1996	H.M.	H.M.	
1	Poiana Sărată BC	21.06.1996	H. M.	H. M.	
8	Valea Uzului BC	05.07.1996	C. M.	C. M	
2	Valea Uzului BC	05.07.1996	C. C.	C. C.	
3	Valea Uzului BC	06.07.1996	C. C.	C. C.	
3	Valea Uzului BC	07.07.1996	H. M.	H. M.	
4	Valea Uzului BC	07.07.1996	C. M.	C. M	
1	Bacău BC	31.08.1996	C. M.	C. M	
2	Ocloş V.Uz.BC	06.07.1997	C. G.	C. G.	
4	Ocloş V.Uz.BC	06.07.1997	C. M.	C. M	
3	Poiana Sărată BC	23.06.2000	G.G.	G.G.	
1	Valea Uzului BC	08.08.2000	C. C.	G. A.	
1	Valea Uzului BC	9.08.2000	P.V.	G.O.	
2	Valea Uzului BC	10.08.2000	P.V.	G.O.	
4	Valea Uzului BC	11.08.2000	G.G.	G.G.	

2	Valea Uzului BC	11.08.2000	G.O.	G.O.	
1	Vânători NT	26.08.2000	G.G.	P.M.	
1	Slănicel BC	28.06.2001	C.M.	C.M.	
1	Poiana Sărată BC	26.07.2001	C.M.	C.M.	
1	Piatra Craiului BV	9.07.2002	G.D.	G.O.	
1	Poiana Sărată BC	25.07.2002	P.M.	P.M.	
3	Sărărie BC	23.06.2003	C.M.	C.M.	
1	Sărărie BC	25.06.2003	G.G.	G.G.	
3	Sărărie BC	26.06.2003	C.M.	C.M.	
1	Piatra Craiului BV	10.07.2003	G.D.	G.G.	
3	Vânători NT	24.06.2004	A.M.	G.G.	
1	Slănic Moldova BC	1.09.2005	G.G.	G.G.	
93	Total				

Genera Dinoptera Mulsant 1863

10. Dinoptera collaris Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
4	Suceava SV	05.08.1962	R. G.	R. G.	R. G.
1	Suceava SV	07.07.1964	R. G.	R. G.	
1	Arama	05.08.1969	R. G.	R. G.	
4	Gorovei SV	15.06.1970	R. G.	R. G.	
1	Comarova CT	17.07.1970	R. G.	R. G.	
1	BerzuNTi BC	25.05.1972	G. A.	G. A.	G.G.
1	Bacău BC	21.08.1992	P. E.	P. E.	
1	Mărăşti BC	23.06.1993	H. M.	H. M.	
1	Valea Uzului BC	12.07.1993	C. M.	C. M	
1	Godovana	16.05.1994	G.A.	P.M.	
1	Valea Uzului BC	08.07.1994	P. E.	P. E.	
2	Buhoci BC	22.05.1995	C. M.	P. M.	
1	Valea Uzului BC	14.07.1995	C. M.	C. M	
1	Valea Uzului BC	16.07.1995	H. M.	H. M.	
1	Valea Uzului BC	17.07.1995	P. V.	P. V.	
1	Buhoci BC	25.05.1996	P. E.	P. E.	
1	Perchiu BC	04.06.1996	G. A.	G. A.	
1	Valea Uzului BC	05.06.1996	C.M.	J.O.	
2	Hemeiuşi BC	20.06.1996	C. M.	C. M	
1	Valea Uzului BC	04.07.1996	C. M.	C. M	
1	Valea Uzului BC	07.07.1996	C. M.	C. M	
2	Valea Uzului BC	06.07.1997	P. E.	P. E.	
1	Valea Uzului BC	07.07.1997	P. E.	P. E.	
1	Valea Uzului BC	11.08.2000	C.C.	G.O.	
1	Vânători NT	08.06.2001	G.G.	G.O.	
1	Hemeiuşi BC	17.05.2002	C.M.	C.M.	
3	Vânători NT	24.06.2004	A.M.	G.G.	
38	Total				

Genera Carilia Mulsant 1863
11. Carilia virginea Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Zugreni SV	28.07.1967	R. G.	R. G.	S. R.
2	Chiril SV	01.08.1968	R. G.	R. G.	
1	Arama IŞ	02.08.1967	R. G.	R. G.	
3	Călimani HG	02.08.1967	R. G.	R. G.	
2	Todireni SV	10.04.1968	R. G.	R. G.	
26	Arama IŞ	05.08.1969	R. G.	R. G.	
4	Comarova CT	17..07.1970	R. G.	R. G.	
6	Zboina BC	27.06.1971	G. A.	G. A.	
7	Prinosu – Mare	15.07.1972	R. G.	R. G.	
5	Prinosu – Mare	17.07.1972	R. G.	R. G.	
12	Bacău BC	09.07.1980	R. G.	R. G.	
2	Valea Uzului BC	13.07.1993	C. M.	C. M	G.G.
1	Valea Uzului BC	14.07.1993	C. M.	C. M	
1	Valea Uzului BC	15.07.1993	C. M.	C. M	
1	Valea Uzului BC	16.07.1993	P. E.	P. E.	
1	Gloduri BC	16.05.1994	H. M.	H. M.	
1	Godovana BC	26.06.1994	G. A.	P. M.	
3	Valea Uzului BC	05.07.1994	H. M.	H. M.	
1	Valea Uzului BC	05.07.1994	G. A.	G. A.	
1	Valea Uzului BC	06.07.1994	P. E.	P. E.	
1	Valea Uzului BC	06.07.1994	G. A.	G. A.	
1	Valea Uzului BC	06.07.1994	H. M.	H. M.	
5	Valea Uzului BC	07.07.1994	G. A.	G. A.	
3	Valea Uzului BC	07.07.1994	P. E.	P. E.	
5	Valea Uzului BC	07.07.1994	H. M.	H. M.	
11	Valea Uzului BC	08.07.1994	H. M.	H. M.	
2	Valea Uzului BC	08.07.1994	C. G.	C. G.	
15	Valea Uzului BC	08.07.1994	P. E.	P. E.	
1	Valea Uzului BC	08.07.1994	G. A.	G. A.	
7	Valea Uzului BC	09.07.1994	C.G.	C.G.	
1	Valea Uzului BC	09.07.1994	C.G.	C.G.	
1	Perchiu BC	27.07.1994	C. M.	C.M.	
1	Racova BC	28.07.1994	C. M.	C. M.	
2	Valea Uzului BC	16.07.1995	H. M.	H. M.	
2	Valea Uzului BC	16.07.1995	G. A.	H. M.	
2	Valea Uzului BC	16.07.1995	G. A.	D. L.	
1	Valea Uzului BC	16.07.1995	P. E.	P. E.	
5	Valea Uzului BC	16.07.1995	C. M.	C. M	
6	Valea Uzului BC	17.07.1995	H. M.	H. M.	
1	Valea Uzului BC	17.07.1995	C. G.	C. G.	
2	Valea Uzului BC	17.07.1995	P. E.	P. E.	
3	Valea Uzului BC	17.07.1995	C. M.	C. M	
1	Valea Uzului BC	17.07.1995	D. L.	D. L.	
1	Valea Uzului BC	18.07.1995	P. E.	P. E.	
1	Valea Budului BC	28.05.1996	D. L.	D. L.	
1	Valea Uzului BC	04.06.1996	C. M.	C.M.	
1	Fântânele Durău NT	09.06.1996	T. B.	T. B.	
11	Valea Uzului BC	04.07.1996	C. M.	C. M	
1	Valea Uzului BC	04.07.1996	H. M.	H. M.	
3	Valea Uzului BC	05.07.1996	C. G.	C. G.	

4	Valea Uzului BC	05.07.1996	C. M.	J. O.	
4	Valea Uzului BC	06.07.1996	C. M.	C. M	
2	Valea Uzului BC	06.07.1996	H. M.	H. M.	
2	Valea Uzului BC	07.07.1996	H. M.	H. M.	
6	Valea Uzului BC	07.07.1996	C. M.	C. M	
1	Liteni BC	16.07.1996	G. A.	G. A.	
2	Bacău BC	31.08.1996	C. M.	C. M	
1	Bibireşti BC	01.06.1997	C. M.	C. G.	
6	Valea Uzului BC	04.07.1997	C. G.	C. G.	
2	Valea Uzului BC	04.07.1997	C. M.	C. M	
2	Valea Uzului BC	04.07.1997	H. M.	H. M.	
2	Valea Uzului BC	05.07.1997	C. M.	C. G.	
2	Valea Uzului BC	05.07.1997	C. M.	P.M.	
1	Valea Uzului BC	06.07.1997	C. G.	C. G.	
5	Valea Uzului BC	06.07.1997	P. E.	P. E.	
1	Valea Uzului BC	06.07.1997	P. O.	P. O.	
1	Valea Uzului BC	07.07.1997	C. M.	C. M	
2	Valea Uzului BC	07.07.1997	H. M.	H. M.	
3	Valea Uzului BC	07.07.1997	P. O.	P. O.	
3	Valea Uzului BC	21.07.1997	C. M.	P. M.	
1	Sărărie BC	23.06.2000	P.E.	P.M.	
1	Sărărie BC	24.06.2000	P.M.	P.M.	
1	Sărărie BC	25.06.2000	C. L.	G. G.	
1	Sărărie BC	25.06.2000	C.L.	G.G.	
1	Valea Uzului BC	08.08.2000	C. C.	G.O.	
1	Valea Uzului BC	09.08.2000	C.C.	G.O.	
1	Valea Uzului BC	09.08.2000	P.E.	G.O.	
2	Valea Uzului BC	11.08.2000	C. C.	G.O.	
1	Valea Uzului BC	11.08.2000	G.O.	G.O.	
2	Sărărie BC	03.07.2002	C.M.	C.M.	
2	Sărărie BC	25.06.2003	G.G.	G.G.	
2	Caşin(ÎNTărcătoarea) BC	02.07.2003	G.G.	G.G.	
2	Piatra Craiului BV	09.07.2003	G. D.	G.G.	
4	Piatra Craiului BV	10.07.2003	G. D.	G.G.	
3	Humărie BC	01.08.2003	C.L.	G.O.	
2	Piatra Craiului BV	21.08.2003	G. D.	G.O.	
3	Vânători NT	24.06.2004	A.M.	G.G.	
1	Cheile Bicazului NT	24.06.2005	G.G.	G.G.	
262	Total				

Genera Pidonia Mulsant 1863
12. Pidonia lurida Fabricius 1792

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Călimani HG	02.08.1967	R. G.	R. G.	S. R.
2	Arama IŞ	05.08.1969	R. G.	R. G.	S. R.
1	Bacău BC	09.07.1980	G. A.	G. A.	
1	Meghiş SB	19.08.1980	G. A.	G. A.	
1	Valea Uzului BC	12.07.1993	G. A.	G. A.	
2	Valea Uzului BC	06.07.1994	H. M.	H. M.	
1	Valea Uzului BC	08.07.1994	C. G.	C. G.	
1	Valea Uzului BC	08.07.1994	P. E.	P. E.	
1	Valea Uzului BC	15.07.1995	P. E.	P. E.	
1	Hemeiuşi BC	17.07.1995	P. V.	P. V.	

2	Valea Uzului BC	07.07.1996	C. M.	C. M	
1	Valea Uzului BC	08.07.1996	C. M.	C. M.	
1	Valea Uzului BC	04.07.1997	C. G.	C. G.	
1	Valea Uzului BC	05.07.1997	C.M.	P.M.	
1	Cheile Turzii CJ	24.06.1998	H.M.	P.M.	G.G.
1	Valea Uzului BC	07.07.1998	M. C.	M. C.	
3	Vânători NT	07.06.2001	G.G.	G.O.	
17	Vânători NT	08.06.2001	G.G.	G.O.	
5	Piatra Craiului BV	08.06.2001	C.M.	C.G.	
1	Piatra Craiului BV	28.06.2001	G.D.	G.O.	
2	Poiana Sărată BC	24.07.2001	A.M.	P.M.	
2	Poiana Sărată BC	25.07.2001	A.M.	P.M.	
1	Sărărie BC	03.06.2002	P.M.	P.M.	
1	Piatra Craiului BV	09.07.2002	G.D.	G.O.	
2	Piatra Craiului BV	09.07.2003	G.D.	G.G.	
54	Total				

Tribe Lepturini
Genera Grammoptera Audinet-Serville 1835
13. Grammoptera ruficornis Fabricius 1781

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Ponoare MH	17.06.1966	R. G.	R. G.	S. R.
1	Total				

Genera Alosterna Mulsant 1863
14. Alosterna tabacicolor Degeer 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Slătioara SV	22.05.1968	R. G.	R. G.	S. R.
1	Arama IŞ	05.08.1969	R. G.	R. G.	
1	Zboina BC	27.06.1971	G. A.	G. A.	
1	Prinosu-Mare	15.07.1972	R. G.	R. G.	
5	Total				

Genera Pseudovadonia Lobanov, Danilevsky et Murzin 1981

15. Pseudovadonia livida Fabricius 1776

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
4	Botoşani BT	18.06.1964	R. G.	R. G.	R. G.
2	Arama	05.08.1968	R. G.	R. G.	
1	Ponoare MH	29.06.1969	R. G.	R. G.	
1	Urecheşti BC	10.06.1970	G. A.	G. A.	S. R.
1	Pietricica BC	10.07.1971	G. A.	G. A.	
5	Cotuşca BT	11.07.1971	R. G.	R. G.	
1	Gârboavele BC	26.05.1972	R. G.	R. G.	
5	Babadag TL	04.06.1972	G. A.	G. A.	
15	Babadag TL	12.06.1973	G. A.	G. A.	
10	Babadag TL	13.06.1973	G. A.	G. A.	
13	Babadag TL	14.06.1973	G. A.	G. A.	
3	Gherăieşti BC	30.06.1973	G. A.	G. A.	
1	Fântânele BC	24.06.1975	G. A.	G. A.	
1	Hemeiuşi BC	16.06.1975	G. A.	G. A.	
1	Gura Văii BC	17.06.1975	G. A.	G. A.	
1	Perchiu BC	03.07.1978	G. A.	G. A.	
1	Măgura BC	05.07.1978	A. V.	A. V.	
1	Perchiu BC	07.07.1978	G. A.	G. A.	
2	Racova BC	26.06.1979	G. A.	G. A.	
1	Hemeiuşi BC	30.06.1980	G. A.	G. A.	
1	Plopana BC	10.08.1981	G. A.	G. A.	
1	Urecheşti BC	27.07.1984	G. A.	G. A.	
1	Bacău BC	04.08.1984	G. A.	G. A.	
4	Prăjeşti BC	11.06.1985	G. A.	G. A.	
1	Prăjeşti BC	11.06.1985	P. E.	P. E.	
3	Bereşti Tazlău BC	13.06.1985	G. A.	G. A.	
1	Racova BC	05.06.1986	P. E.	P. E.	
1	Poduri BC	28.06.1990	G. A.	G. A.	
1	Udeşti SV	16.08.1992	P. E.	P. E.	
3	Valea Uzului BC	12.07.1993	P. E.	P. E.	
1	Valea Uzului BC	13.07.1993	C. M.	C. M.	
1	Valea Uzului BC	14.07.1993	P. E.	P. E.	
1	Valea Uzului BC	15.07.1993	H. M.	H. M.	
2	Valea Uzului BC	15.07.1993	P. E.	P. E.	
2	Valea Uzului BC	06.07.1994	H. M.	H. M.	
2	Valea Uzului BC	07.07.1994	P. E.	P. E.	
1	Valea Uzului BC	07.07.1994	G. A.	G. A.	
1	Valea Uzului BC	07.07.1994	H. M.	H. M.	
1	Găiceana BC	01.08.1994	G. A.	G. A.	
1	Sânpetru Mare TM	11.05.1995	C. M.	C. M.	
4	Racova BC	05.06.1995	D. L.	D. L	
1	Vânători NT	20.06.1995	P. E.	P. M.	
1	Perchiu BC	13.07.1995	P. E.	P. E.	
1	Valea Uzului BC	15.07.1995	P. E.	P. E.	
2	Valea Uzului BC	16.07.1995	P. E.	P. E.	
1	Valea Uzului BC	17.07.1995	P. E.	P. E.	

1	Valea Uzului BC	17.07.1995	H. M.	H. M.	
2	Runc BC	04.08.1995	H. M.	H. M.	
7	Buhoci BC	22.05.1996	G. A.	P. M.	
1	Valea Budului BC	25.06.1996	G. A.	P. M.	
1	Gherăieşti BC	10.06.1996	C. C.	C. C.	
1	Hemeiuşi BC	18.06.1996	C. C.	C. C.	
2	Hemeiuşi BC	18.06.1996	G. A.	G. A.	
1	Hemeiuşi BC	22.06.1996	P. O.	P. O.	
2	Luncani BC	29.06.1997	F. F.	P. M.	
1	Valea Uzului BC	05.07.1997	P. E.	P. E.	
1	Sărărie BC	25.06.2000	C. L.	G. G.	G. G.
3	Sărărie BC	27.06.2000	G. G.	G. G.	
133	Total				

Genera Vadonia Mulsant 1863
16. Vadoniaia steveni Sperk 1835

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	L.Sinoe CT	02.06.1972	G. A.	G. A.	G. G.
3	Istria CT	03.06.1972	G. A.	G. A.	
5	Total				

Genera Anoplodera Mulsant 1839
17. Anoplodera sexguttata Fabricius 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Piatra Craiului BV	22.05.2002	F. F.	H. M.	G.G.
1	Căiuţi BC	29.05.2003	C.L.	G.G.	
2	Total				

18. Anoplodera rufipes Schaller 1783

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Dorohoi SV	23.05.1971	R. G.	R. G.	R. G.
1	Valea Budului BC	17.05.2000	P.E.	P.E.	G. G.
2	Total				

Genera Lepturobosca Reitter 1912
19. Lepturobosca virens Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
3	Valea Colbu SV	02.08.1966	R. G.	R. G.	S. R.
8	Călimani HG	02.08.1967	R. G.	R. G.	
20	Arama SV	05.08.1969	R. G.	R. G.	
1	Prinosu Mare SV	15.07.1972	R. G.	R. G.	
4	Prinosu Mare SV	15.07.1972	R. G.	R. G.	
1	Valea Uzului BC	08.05.1994	H. M.	H. M.	
1	Hemeiuşi BC	30.05.1995	H.M.	H.M.	
1	Valea Uzului BC	16.07.1995	H. M.	H. M.	
1	Valea Uzului BC	02.07.1996	H. M.	H. M.	

1	Valea Uzului BC	06.07.1996	C. M.	C. M.	
1	Valea Uzului BC	06.07.1996	C. G.	C. G.	
1	Piatra Craiului BV	10.06.2003	C.L.	G.G.	G. G.
1	Sărărie BC	26.06.2003	C.M.	C.M.	
44	Total				

Genera Aredolpona Nakane et Ohbayashi 1957
20. Aredolpona rubra Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
3	Poiana Stampei SV	05.08.1965	R. G.	R. G.	R. G.
4	Izvorul Alb BC	31.07.1970	R. G.	R. G.	
1	BerzuNTi BC	25.05.1972	G. A.	G. A.	S. R.
4	Valea Frumoasei BC	15.07.1972	G. A.	G. A.	
1	Vereşti SV	09.08.1973	G. A.	G. A.	
1	Oneşti BC	07.08.1974	G. A.	G. A.	
1	Scutaru BC	08.08.1974	G. A.	G. A.	
1	Apa Roşie BC	25.07.1975	G. A.	G. A.	
4	Lacul Roşu NT	07.08.1982	A. V.	A. V.	
3	Slănic Moldova BC	18.08.1991	P. E.	P. E.	
1	Valea Uzului BC	12.07.1993	G. A.	G. A.	
1	Valea Uzului BC	12.07.1993	P. E.	P. E.	
1	Valea Uzului BC	14.07.1993	P. E.	P. E.	
2	Valea Uzului BC	14.07.1993	G. A.	G. A.	
1	Valea Uzului BC	15.07.1993	G. A.	G. A.	
1	Valea Uzului BC	15.07.1993	H. M.	H. M.	
5	Valea Uzului BC	15.07.1993	C. M.	C. M.	
5	Valea Uzului BC	16.07.1993	H. M.	H. M.	
4	Valea Uzului BC	16.07.1993	G. A.	G. A.	
1	Valea Uzului BC	16.07.1993	P. E.	P. E.	
1	Hemeiuşi BC	02.06.1994	H. M.	H. M.	
1	Valea Uzului BC	05.07.1994	H. M.	H. M.	
2	Valea Uzului BC	05.07.1994	P. E.	P. E.	
6	Valea Uzului BC	06.07.1994	H. M.	H. M.	
1	Valea Uzului BC	06.07.1994	G. A.	G. A.	
2	Valea Uzului BC	06.07.1994	P. E.	P. E.	
1	Valea Uzului BC	06.07.1994	C. G.	C. G.	
9	Valea Uzului BC	07.07.1994	H. M.	H. M.	
2	Valea Uzului BC	07.07.1994	P. E.	P. E.	
2	Valea Uzului BC	07.07.1994	G. A.	G. A.	
10	Valea Uzului BC	08.07.1994	P. E.	P. E.	
3	Valea Uzului BC	08.07.1994	H. M.	H. M.	
1	Hemeiuşi BC	28.07.1994	D. L.	D. L	
1	Runc BC	29.07.1994	G. A.	G. A.	
1	Sânpetru –Mare	11.05.1995	C. M.	C. M.	
1	Valea Uzului BC	07.06.1995	P. V.	P. V.	
1	Valea Uzului BC	07.07.1995	H. M.	H. M.	
8	Valea Uzului BC	07.07.1995	C. M.	C. M.	
1	Valea Uzului BC	08.07.1995	G. A.	G. A.	
3	Valea Uzului BC	15.07.1995	P. E.	P. E.	
1	Valea Uzului BC	15.07.1995	G. A.	G. A.	
11	Valea Uzului BC	16.07.1995	C. M.	C. M.	
6	Valea Uzului BC	16.07.1995	P. E.	P. E.	
2	Valea Uzului BC	16.07.1995	G. A.	G. A.	
7	Valea Uzului BC	17.07.1995	P. E.	P. E.	
5	Valea Uzului BC	17.07.1995	H. M.	H. M.	

9	Valea Uzului BC	17.07.1995	C. M.	C. M.	
1	Valea Uzului BC	17.07.1995	D. L.	D. L	
9	Valea Uzului BC	19.07.1995	C. M.	C. M.	
7	Valea Uzului BC	19.07.1995	P. E.	P. E.	
1	Valea Uzului BC	19.07.1995	H. M.	H. M.	
1	Slănic Moldova BC	01.08.1995	H. M.	H. M.	
2	Runc BC	04.08.1995	H. M.	H. M.	
1	Slănic Moldova BC	11.08.1995	C. M.	C. M.	
1	Valea Uzului BC	04.07.1996	C. M.	C. M.	
2	Valea Uzului BC	05.07.1996	C. M.	J. O.	
1	Valea Uzului BC	05.07.1996	H. M.	H. M.	
1	Valea Uzului BC	07.07.1996	H. M.	H. M.	
3	Valea Uzului BC	07.07.1996	C. M.	C. M.	
1	Poiana Sărată BC	18.07.1996	G. A.	G. A.	
1	Poiana Sărată BC	18.07.1996	G. A.	P. M.	
1	Poiana Sărată BC	18.07.1996	G. A.	G. A.	
2	Poiana Sărată BC	21.07.1996	P. E.	P. E.	
3	Poiana Sărată BC	21.07.1996	H. M.	H. M.	
1	Poiana Sărată BC	21.07.1996	P.E.	P.E.	
1	Valea Uzului BC	05.07.1997	C. M.	C. G.	
2	Valea Uzului BC	06.07.1997	C. M.	C. M.	
1	Valea Uzului BC	06.07.1997	P. E.	P. E.	
1	Valea Uzului BC	06.07.1997	C. G.	C. G.	
1	Valea Uzului BC	07.07.1998	M. C.	M. C.	G. G.
7	Valea Uzului BC	21.07.1998	C. M	P. M	
1	Valea Uzului BC	21.07.1998	C.M.	C.M.	
1	Izvorul Alb BC	30.07.1998	C. M.	C. M.	
6	Izvorul Alb BC	24.07.1999	C. M.	G. G.	
1	Izvorul Alb BC	24.07.1999	H.M.	G.O.	
5	Izvorul Alb BC	27.07.1999	C. M.	G. G.	
1	Sărărie BC	25.06.2000	C.L.	P.M.	
1	Sărărie BC	27.06.2000	G.G.	G.G.	
1	Sărărie BC	28.06.2000	R.S.	P.M.	
2	Sărărie BC	28.06.2000	P.M.	P.M.	
1	Sărărie BC	28.06.2000	G.G.	G.G.	
1	Sărărie BC	29.06.2000	G.G.	P.M.	
1	Sărărie BC	29.06.2000	G.G.	G.O.	
1	Nemţişor NT	11.07.2000	T.B.	G.G.	
1	Vânători NT	26.07.2000	G.G.	G.O.	
1	Vânători NT	27.07.2000	G.G.	P.M.	
1	Vânători NT	28.07.2000	G.G.	G.G.	
1	Vânători NT	28.07.2000	C.L.	C.L.	
1	Vânători NT	29.07.2000	G.G.	G.O.	
2	Vânători NT	30.07.2000	C.M.	G.G.	
1	Vânători NT	30.07.2000	G.G.	P.M.	
1	Vânători NT	07.08.2000	G.G.	G.G.	
3	Valea Uzului BC	09.08.2000	P.V.	G.O.	
1	Valea Uzului BC	09.08.2000	G.O.	G.O.	
1	Valea Uzului BC	10.08.2000	C.C.	P.M.	
3	Valea Uzului BC	10.08.2000	P.V.	G.O.	
5	Valea Uzului BC	11.08.2000	G.O.	G.O.	
3	Valea Uzului BC	11.08.2000	C.C.	G.O.	
4	Valea Uzului BC	11.08.2000	C.C.	G.G.	
3	Vânători NT	30.09.2000	G.G.	G.O.	
1	Piatra Craiului BV	07.06.2001	H.M.	H.M.	
1	Poiana Sărată BC	16.07.2001	G.G.	G.O.	
4	Poiana Sărată BC	23.07.2001	P.M.	P.M.	

1	Poiana Sărată BC	23.07.2001	G.G.	G.O.	
2	Poiana Sărată BC	26.07.2001	P.M.	P.M.	
1	Poiana Sărată BC	22.07.2002	H.M.	H.M.	
1	Poiana Sărată BC	23.07.2002	P.M.	P.M.	
1	Poiana Sărată BC	25.07.2002	H.M.	G.O.	
1	Poiana Sărată BC	26.07.2002	P.M.	P.M.	
3	Piatra Craiului BV	28.06.2003	G.D.	G.O.	
1	Piatra Craiului BV	10.07.2003	G.D.	G.G.	
1	Văratec NT	18.07.2003	T.B.	G.O.	
1	Poiana Sărată BC	23.07.2003	G.G.	G.G.	
269	Total				

Genera Paracorymbia Miroshnikov 1998
Subgenera Paracorymbia Miroshnikov 1998
21. Paracorymbia erythroptera Hagenbach 1822

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Poiana Sărată BC	23.07.2001	P.E.	P.M.	G. G.
1	Total				

22. Paracorymbia maculicornis Degeer 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Valea Colbu SV	02.08.1966	R. G.	R. G.	R. G.
1	Prinosu-Mare	17.07.1972	R. G.	R. G.	
1	Valea Uscată HG	14.08.1978	G. A.	G. A.	G. G.
2	Valea Uzului BC	14.07.1993	H. M.	H. M.	
1	Valea Uzului BC	14.07.1993	P. E.	P. E.	
1	Valea Uzului BC	16.07.1993	P. E.	P. E.	
1	Valea Uzului BC	05.07.1994	H. M.	H. M.	
1	Valea Uzului BC	05.07.1994	P. E.	P. E.	
1	Valea Uzului BC	06.07.1994	P. E.	P. E.	
1	Valea Uzului BC	06.07.1994	H. M.	H. M.	
4	Valea Uzului BC	07.07.1994	P. E.	P. E.	
3	Valea Uzului BC	08.07.1994	P. E.	P. E.	
3	Valea Uzului BC	08.07.1994	G. A.	G. A.	
2	Valea Uzului BC	08.07.1994	H. M.	H. M.	
4	Valea Uzului BC	09.07.1994	C. G.	C. G.	
2	Perchiu BC	27.07.1994	P. E.	P. M.	
1	Hemeiuşi BC	04.08.1994	D. L.	D. L	
1	Valea Uzului BC	15.07.1995	P. E.	P. E.	
3	Valea Uzului BC	17.07.1995	H. M.	H. M.	
1	Valea Uzului BC	17.07.1995	P. V.	P. V.	
5	Valea Uzului BC	17.07.1995	C. M.	C. M.	
1	Buhoci BC	22.05.1996	G. A.	G. A.	
6	Valea Uzului BC	04.07.1996	C. M.	C. M.	
2	Valea Uzului BC	07.07.1996	C. M.	C. M.	
1	Moghioroş BC	06.07.1997	P. E.	P. E.	
1	Valea Uzului BC	08.07.1997	P. E.	P. E.	
1	Valea Uzului BC	07.07.1998	P. O.	P. O.	
3	Valea Uzului BC	21.07.1998	C. M.	C. M.	
1	Valea Uzului BC	24.07.1998	P.M.	P.M.	
1	Oneşti BC	19.08.1998	P.M.	P.M.	
1	Poiana Sărată BC	23.06.2001	G.G.	G.O.	
2	Poiana Sărată BC	26.06.2001	C.M.	C.M.	
1	Sărărie BC	25.06.2003	G.G.	G.G.	
4	Vânători NT	22.06.2004	A.M.	G.G.	
1	Slănic Moldova BC	26.07.2004	A.M.	G.G.	
67	Total				

Genera Paracorymbia Miroshnikov 1998
Subgenera Melanoleptura Miroshnikov 1998
23.Paracorymbia scutellata Fabricius 1781

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Perchiu-Oneşti BC	06.06.1992	G. A.	P.M.	G.G.
1	Valea Uzului BC	05.07.1994	P. V.	P. M.	
1	Slănic Moldova BC	11.07.1995	H.M.	C.M.	
1	Valea Uzului BC	16.07.1995	G. A.	P. E.	
1	Valea Uzului BC	16.07.1995	P. E.	P. E.	
3	Valea Uzului BC	16.07.1995	C. M.	C. M.	
2	Valea Uzului BC	17.07.1995	H. M.	H. M.	
2	Valea Uzului BC	17.07.1995	C. M.	C. M.	
4	Valea Uzului BC	19.07.1995	C. M.	C. M.	
1	Valea Uzului BC	07.06.1996	H. M.	H. M.	
4	Valea Uzului BC	07.06.1996	H. M.	C.G.	
1	Valea Uzului BC	04.07.1996	C. M.	C. M.	
1	Valea Uzului BC	05.07.1996	C. M.	J. O.	
3	Valea Uzului BC	05.07.1996	C. M.	C. G.	
1	Valea Uzului BC	05.07.1996	P. V.	P. M.	
1	Valea Uzului BC	06.07.1996	H. M.	H. M.	
1	Valea Uzului BC	06.07.1996	C.C.	C.C.	
7	Valea Uzului BC	07.07.1996	C. M.	C. M.	
8	Poiana Sărată BC	21.07.1996	P. E.	P. E.	
1	Bacău BC	31.08.1996	C. M.	C. M.	
1	Caşin BC	03.05.1997	C. M.	C. M.	
1	Valea Uzului BC	21.07.1998	C. M.	C. M.	
1	Izvorul Alb BC	24.07.1999	C. M.	G. G.	
1	Runc BC	09.05.2000	H. M.	H. M.	
1	Sărărie BC	28.06.2000	P.M.	P.M.	
1	Sărărie BC	29.06.2000	G. G.	P.M.	
2	Sărărie BC	29.06.2000	P.M.	P.M.	
1	Poiana Sărată BC	25.07.2000	J. O.	G. O.	
1	Poiana Sărată BC	25.07.2000	H. M.	G. O.	
2	Vânători NT	26.07.2000	G. G.	P.M.	
2	Poiana Sărată BC	26.07.2000	M.C.	G.O.	
1	Vânători NT	27.07.2000	G. G.	G. G.	
1	Valea Uzului BC	09.08.2000	P. V.	G. O.	
3	Valea Uzului BC	10.08.2000	P. V.	G. O.	
2	Valea Uzului BC	11.08.2000	G. O.	G. O.	
5	Slănicel BC	28.06.2001	C. M.	C. M.	
6	Poiana Sărată BC	23.07.2001	P. M.	P. M.	
2	Poiana Sărată BC	23.07.2001	P. E.	P. M.	
2	Poiana Sărată BC	23.07.2001	G. G.	G. O.	
9	Poiana Sărată BC	24.07.2001	G. G.	G. O.	
1	Poiana Sărată BC	24.07.2001	P. M.	P. M.	
2	Poiana Sărată BC	25.07.2001	P. M.	P. M.	
2	Poiana Sărată BC	25.07.2001	G. G.	G. O.	
2	Poiana Sărată BC	26.07.2001	C. M.	C. M.	
1	Sărărie BC	03.07.2002	C. M.	C. M.	
3	Poiana Sărată BC	22.07.2002	H. M.	H. M.	
2	Poiana Sărată BC	23.07.2002	P. M.	P. M.	
3	Poiana Sărată BC	24.07.2002	H. M.	G. O.	
4	Poiana Sărată BC	24.07.2002	C. M.	C. M.	
3	Poiana Sărată BC	24.07.2002	G. G.	G. O.	
3	Poiana Sărată BC	25.07.2002	G. G.	G. O.	

6	Poiana Sărată BC	25.07.2002	H. M.	G. O.	
3	Poiana Sărată BC	26.07.2002	P. M.	P. M.	
14	Poiana Sărată BC	10.08.2002	H. M.	G. O.	
4	Poiana Sărată BC	12.08.2002	H. M.	G. O.	
5	Piatra Craiului BV	07.06.2003	G. D.	P. M.	
2	Sărărie BC	23.06.2003	C. M.	C. M.	
1	Sărărie BC	26.06.2003	C. M.	C. M.	
1	Piatra Craiului BV	10.07.2003	G. D.	P. M.	
1	Piatra Craiului BV	10.07.2003	G. D.	G. G.	
16	Piatra Craiului BV	21.07.2003	G. D.	P. M.	
3	Poiana Sărată BC	22.07.2003	A. M.	G. O.	
4	Poiana Sărată BC	22.07.2003	C. M.	C. M.	
8	Poiana Sărată BC	23.07.2003	C. M.	C. M.	
1	Poiana Sărată BC	23.07.2003	H. M.	H. M.	
5	Poiana Sărată BC	23.07.2003	A. M.	G. O.	
5	Poiana Sărată BC	24.07.2003	A. M.	G. O.	
1	Vânători NT	23.06.2004	A. M.	G. G.	
1	Slănic Moldova BC	27.07.2004	A. M.	G. G.	
3	Sărărie BC	18.08.2004	A. M.	G. G.	
2	Sărărie BC	19.08.2004	A. M.	G. G.	
202	Total				

Genera Anastrangalia Casey 1924
24. Anastrangalia sanguinolenta Linnaeus 1761

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
7	Arama IŞ	05.08.1969	R. G.	R. G.	S.R
1	Izvorul Alb BC	31.07.1970	R. G.	R. G.	
1	Zboina BC	27.06.1971	G. A.	G. A.	
1	BerzuNTi BC	25.05.1972	G. A.	G. A.	
1	Valea Uzului BC	12.07.1993	C. M.	C. M.	
1	Valea Uzului BC	13.07.1993	C. M.	C. M.	
3	Valea Uzului BC	14.07.1993	H. M.	H. M.	
1	Godovana BC	16.05.1994	G. A.	G. A.	
1	Valea Uzului BC	05.07.1994	H. M.	H. M.	
1	Valea Uzului BC	07.07.1994	H. M.	H. M.	
1	Valea Uzului BC	07.07.1994	G. A.	G. A.	
1	Valea Uzului BC	08.07.1994	G. A.	G. A.	
1	Valea Uzului BC	08.07.1994	H. M.	H. M.	
1	Valea Uzului BC	09.07.1994	C. G.	C. G.	
1	Valea Uzului BC	16.07.1995	C. M.	C. M.	
1	Runc BC	04.08.1995	H. M.	H. M.	
1	Slănic Moldova BC	11.08.1995	C. M.	C. M.	
1	Valea Uzului BC	04.07.1996	C. M.	C. M.	
1	Valea Uzului BC	05.07.1996	C. M.	J. O.	
1	Valea Uzului BC	04.07.1997	H. M.	H. M.	
1	Valea Uzului BC	06.07.1997	C. M.	H. M.	
1	Valea Uzului BC	07.07.1997	C. G.	C. G.	
3	Valea Uzului BC	07.07.1997	H. M.	H. M.	
33	Total				

25. Anastrangalia dubia Scopoli 1763

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Chiril SV	01.08.1962	R. G.	R. G.	R. G.
1	Vatra Dornei SV	03.08.1962	R. G.	R. G.	
2	Valea Colbu SV	02.08.1966	R. G.	R. G.	
5	Călimani HG	25.07.1967	R. G.	R. G.	
1	Zugreni SV	28.07.1967	R. G.	R. G.	
1	Valea Colbu SV	29.07.1967	R. G.	R. G.	
3	Prinosu Mare SV	15.07.1972	R. G.	R. G.	
5	Prinosu Mare SV	17.07.1972	R. G.	R. G.	
19	Total				

Genera Judolia Mulsant 1863
26. Judolia sexmaculata Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	13.07.1993	G. A.	G. A.	G. G.
1	Valea Uzului BC	04.07.1996	C.M.	C.M.	
1	Poiana Sărată BC	21.07.1997	P.E.	P.E.	
1	Valea Uzului BC	06.07.1997	C.M.	C.M.	
4	Total				

Genera Pachytodes Pic 1891
27. Pachytodes cerambyciformis Schrank 1781

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sohodol BC	21.06.1962	G. A.	G. A.	S. R.
1	Valea Bistriței SV	30.07.1967	R. G.	R. G.	
1	Chiril SV	01.08.1967	R. G.	R. G.	
1	Arama IS	05.08.1969	R. G.	R. G.	
1	Mărăşti BC	23.06.1993	H. M.	H. M.	
2	Valea Uzului BC	12.07.1993	G. A.	G. A.	
4	Valea Uzului BC	13.07.1993	C. M.	C. M.	
1	Valea Uzului BC	14.07.1993	P. E.	P. E.	
3	Valea Uzului BC	14.07.1993	H. M.	H. M.	
1	Valea Uzului BC	15.07.1993	H. M.	H. M.	
5	Valea Uzului BC	15.07.1993	C. M.	C. M.	
1	Valea Uzului BC	16.07.1993	H. M.	H. M.	
1	Valea Uzului BC	16.07.1993	G. A.	G. A.	
1	Valea Uzului BC	16.07.1993	H. M.	H. M.	
1	Valea Uzului BC	05.07.1994	C. G.	C. G.	
1	Valea Uzului BC	05.07.1994	H. M.	H. M.	
8	Valea Uzului BC	06.07.1994	H. M.	H. M.	
3	Valea Uzului BC	06.07.1994	P. E.	P. E.	
4	Valea Uzului BC	07.07.1994	P. E.	P. E.	
1	Valea Uzului BC	07.07.1994	H. M.	H. M.	
1	Valea Uzului BC	07.07.1994	G. A.	G. A.	
20	Valea Uzului BC	08.07.1994	P. E.	P. E.	
4	Valea Uzului BC	08.07.1994	C. G.	C. G.	
4	Valea Uzului BC	08.07.1994	H. M.	H. M.	
1	Valea Uzului BC	08.07.1994	G. A.	G. A.	
2	Valea Uzului BC	09.07.1994	C. G.	C. G.	

4	Valea Uzului BC	15.07.1995	P. E.	P. E.	
3	Valea Uzului BC	15.07.1995	G. A.	G. A.	
2	Valea Uzului BC	16.07.1995	A. V.	A. V.	
8	Valea Uzului BC	16.07.1995	G. A.	G. A.	
4	Valea Uzului BC	16.07.1995	P. E.	P. E.	
5	Valea Uzului BC	16.07.1995	H. M.	H. M.	
14	Valea Uzului BC	16.07.1995	C. M.	C. M.	
1	Valea Uzului BC	17.07.1995	D. L.	D. L.	
6	Valea Uzului BC	17.07.1995	P. E.	P. E.	
8	Valea Uzului BC	17.07.1995	H. M.	H. M.	
13	Valea Uzului BC	17.07.1995	C. M.	C. M.	
11	Valea Uzului BC	19.07.1995	P. E.	P. E.	
6	Valea Uzului BC	19.07.1995	C. M.	C. M.	
2	Runc BC	04.08.1995	H. M.	H. M.	
1	Slănic Moldova BC	10.08.1995	H. M.	H. M.	
5	Slănic Moldova BC	10.08.1995	C. M.	C. M.	
1	Valea Uzului BC	08.06.1996	T. B.	T. B.	
2	Poiana Sărată BC	21.06.1996	H. M.	H. M.	
2	Poiana Sărată BC	21.06.1996	G. A.	G. A.	
2	Bălăneşti BC	24.06.1996	P. E.	P. M.	
12	Valea Uzului BC	04.07.1996	C. M.	C. M.	
16	Valea Uzului BC	05.07.1996	C. M.	J. O.	
2	Valea Uzului BC	05.07.1996	C. C.	C. C.	
2	Valea Uzului BC	06.07.1996	H. M.	H. M.	
15	Valea Uzului BC	07.07.1996	C. M.	C. M.	
2	Poiana Sărată BC	17.07.1996	P. E.	P. E.	
1	Gherăieşti BC	07.08.1996	P. E.	P. E.	
1	Bacău BC	31.08.1996	C. M.	C. M.	
1	Bibireşti BC	01.06.1997	C. M.	C. M.	
1	Valea Uzului BC	04.07.1997	C. M.	C. M.	
2	Valea Uzului BC	04.07.1997	C. G.	C. G.	
1	Valea Uzului BC	05.07.1997	C. M.	C. G.	
1	Valea Uzului BC	05.07.1997	P. E.	P. E.	
1	Valea Uzului BC	06.07.1997	C. G.	C. G.	
1	Valea Uzului BC	06.07.1997	C. M.	C. M.	
1	Valea Uzului BC	06.07.1997	P. E.	P. E.	
1	Valea Uzului BC	07.07.1997	P. E.	P. E.	
1	Valea Uzului BC	07.07.1997	J. O.	J. O.	
1	Poiana Sărată BC	18.07.1997	G. A.	G. A.	
1	Oneşti BC	04.08.1997	H. M.	H. M.	
1	Făget CJ	21.06.1998	H. M.	H. M.	G. G.
1	Valea Uzului BC	05.07.1998	C. M.	C. G.	
1	Valea Uzului BC	21.07.1998	C. M.	C. G.	
4	Valea Uzului BC	21.07.1998	C. M.	P. M.	
2	Izvorul Alb BC	27.07.1999	C. M.	G. G.	
1	Sărărie BC	25.06.2000	C. L.	G. G.	
248	Total				

28. Pachytodes erraticus Dalman 1817

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Traian BC	07.04.1960	G. A.	G. A.	S. R.
5	Sohodol BC	21.06.1962	G. A.	G. A.	
3	Sohodol BC	22.06.1962	G. A.	G. A.	
1	Arama IŞ	05.08.1969	G. A.	G. A.	
1	Perchiu BC	06.07.1970	G. A.	G. A.	

2	Todireni SV	28.06.1970	R. G.	R. G.	
3	Gorovei BT	08.06.1971	R. G.	R. G.	
1	Măgura BC	11.07.1971	G. A.	G. A.	
1	Slătioara SV	13.07.1972	R. G.	R. G.	
1	Valea Frumoasei BC	14.07.1972	G. A.	G. A.	
1	Babadag TL	14.06.1973	G. A.	G. A.	
8	Bacău BC	21.07.1993	G. A.	G. A.	
1	Vânători NT	29.07.2000	G.G.	G.G.	G. G.
29	Total				

Genera Leptura Linnaeus 1758
29. Leptura quadrifasciata Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Obcioara SV	27.08.1963	A.L.	A.L.	R. G.
1	Arama	05.08.1969	R. G.	R. G.	
1	Valea Uzului BC	12.07.1993	P. E.	P. E.	G. G.
1	Valea Uzului BC	15.07.1993	C. M.	C. M.	
1	Valea Uzului BC	16.07.1993	C. M.	C. M.	
1	Valea Uzului BC	06.07.1994	H. M.	H. M.	
1	Valea Uzului BC	06.07.1994	P. E.	P. E.	
2	Valea Uzului BC	07.07.1994	P. E.	P. E.	
3	Valea Uzului BC	07.07.1994	G. A.	G. A.	
5	Valea Uzului BC	08.07.1994	P. E.	P. E.	
1	Valea Uzului BC	07.07.1994	C. G.	C. G.	
1	Slănic Moldova BC	11.07.1995	H. M.	H. M.	
2	Sl .Moldova BC	12.07.1995	P. E.	P. E.	
2	Valea Uzului BC	16.07.1995	P. E.	P. E.	
2	Valea Uzului BC	16.07.1995	H. M.	H. M.	
1	Valea Uzului BC	16.07.1995	G. A.	G. A.	
2	Valea Uzului BC	17.07.1995	H. M.	H. M.	
3	Valea Uzului BC	17.07.1995	C. M.	C. M.	
3	Valea Uzului BC	19.07.1995	P. E.	P. E.	
1	Valea Uzului BC	19.07.1995	C. M.	C. M.	
2	Poiana Sărată BC	21.06.1996	H. M.	H. M.	
1	Valea Uzului BC	05.07.1996	C. C.	C. C.	
1	Valea Uzului BC	05.07.1996	C. M.	C. M.	
2	Valea Uzului BC	06.07.1996	H. M.	H. M.	
2	Valea Uzului BC	07.07.1996	H. M.	H. M.	
2	Valea Uzului BC	07.07.1996	C. M.	C. M.	
1	Valea Uzului BC	07.07.1996	G. A.	G. A.	
2	Valea Uzului BC	08.07.1996	C. G.	C. G.	
1	Valea Uzului BC	08.07.1996	B. T.	B. T.	
1	Gherăieşti BC	07.08.1996	P. E.	P. E.	
1	Bacău BC	31.08.1996	C. M.	C. M.	
1	M.Caşin BC	03.05.1997	C. M.	C. M.	
1	Valea Uzului BC	05.07.1997	P. E.	P. E.	
1	Valea Uzului BC	06.07.1997	C. G.	C. G.	
3	Valea Uzului BC	06.07.1997	C. M.	C. M.	
1	Valea Uzului BC	06.07.1997	P. E.	P. E.	
2	Valea Uzului BC	07.07.1997	C. G.	C. G.	
3	Valea Uzului BC	07.07.1997	C. M.	C. M.	
1	Valea Uzului BC	07.07.1997	H. M.	H. M.	
4	Izvorul Alb BC	24.07.1999	C. M.	G. G.	
1	Sărărie BC	25.06.2000	C.L.	C.L.	
1	Valea Uzului BC	11.08.2000	C. C.	G. O.	

1	Poiana Sărată BC	25.08.2000	H.M.	G.O.	
3	Poiana Sărată BC	26.07.2001	G.G.	G.G.	
1	Sărărie BC	03.07.2002	C. M.	C. M.	
1	Poiana Sărată BC	25.07.2002	P.M.	P.M.	
1	Piatra Craiului BV	20.06.2003	C.L.	C.L.	
1	Piatra Craiului BV	20.06.2003	P.O.	P.O.	
4	Sărărie BC	25.06.2003	G.G.	G.G.	
2	Poiana Sărată BC	23.07.2003	P.E.	P.M.	
2	Poiana Sărată BC	23.07.2003	C.M.	C.M.	
1	Poiana Sărată BC	25.07.2003	C.M.	C.M.	
1	Ceahlău NT	11.08.2004	T.B.	G.G.	
2	Sărărie BC	17.08.2004	A.M.	G.G.	
1	Sărărie BC	18.08.2004	A.M.	G.G.	
1	Sărărie BC	19.08.2004	A.M.	G.G.	
1	Poiana Sărată BC	23.06.2004	G.G.	G.G.	
1	Slănic Moldova BC	03.09.2005	P.M.	P.M.	
94	Total				

30. Leptura aurulenta Fabricius 1792

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Racova BC	08.08.1978	G. A.	G. A.	S.R.
1	Runc BC	04.08.1995	H.M.	H.M.	G.G.
1	Poiana Sărată BC	23.07.2002	H.M.	H.M.	
1	Poiana Sărată BC	24.07.2002	C.M.	C.M.	
3	Poiana Sărată BC	25.07.2002	P.M.	P.M.	
1	Poiana Sărată BC	26.07.2002	P.M.	P.M.	
1	Poiana Sărată BC	23.07.2003	C.M.	C.M.	
9	Total				

31. Leptura annularis Fabricius 1801

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	15.07.1993	C. M.	C. M.	S. R.
1	Valea Uzului BC	05.07.1994	H. M.	H. M.	
3	Valea Uzului BC	07.07.1994	P. E.	P. E.	
1	Valea Uzului BC	07.07.1994	G. A.	G. A.	
1	Valea Uzului BC	07.07.1994	H. M.	H. M.	
1	Valea Uzului BC	08.07.1994	H. M.	H. M.	
2	Valea Uzului BC	08.07.1994	P. E.	P. E.	
1	Bacău BC	03.08.1994	P. E.	P. E.	
1	Valea Uzului BC	16.07.1995	C. M.	C. M.	
1	Valea Uzului BC	17.07.1995	D. L.	D. L.	
2	Valea Uzului BC	17.07.1995	H. M.	H. M.	
3	Valea Uzului BC	17.07.1995	C. M.	C. M.	
6	Valea Uzului BC	04.07.1996	C. M.	C. M.	G. G.
6	Valea Uzului BC	05.07.1996	C. M.	J. O.	
1	Valea Uzului BC	06.07.1996	C. M.	C. M.	
12	Valea Uzului BC	07.07.1996	C. M.	C. M.	
2	Valea Uzului BC	07.07.1996	H. M.	C. G.	
1	Valea Uzului BC	31.08.1996	C. M.	C. M.	
1	Valea Uzului BC	05.07.1997	P. E.	P. E.	
2	Valea Uzului BC	05.07.1997	C. M.	C. G.	
1	Valea Uzului BC	06.07.1997	C. M.	H. M.	

1	Valea Uzului BC	06.07.1997	C. G.	C. G.	
1	Valea Uzului BC	07.07.1997	C. G.	H. M.	
1	Făget CJ	21.06.1998	C. M.	C. M.	
1	Făget CJ	21.06.1998	H. M.	P. M.	
1	Vânători NT	08.06.2000	G.G.	G.G.	
2	Sărărie BC	23.06.2000	P.E.	P.E.	
1	Valea Uzului BC	08.08.2000	C. C.	G. A.	
1	Valea Uzului BC	10.08.2000	P.V.	G.O.	
2	Piatra Craiului BV	08.06.2001	C.M.	C.M.	
1	Sărărie BC	29.06.2001	P.M.	P.M.	
2	Poiana Sărată BC	25.07.2001	P.M.	P.M.	
1	Piatra Craiului BV	20.06.2003	C.L.	C.L.	
1	Sărărie BC	25.06.2003	G.G.	G.G.	
1	Poiana Sărată BC	22.07.2003	C.M.	C.M.	
1	Sărărie BC	23.06.2003	C.M.	C.M.	
1	Poiana Sărată BC	22.06.2004	C.M.	C.M.	
1	Poiana Sărată BC	23.06.2004	G.G.	G.G.	
70	Total				

32.Leptura aethoips Poda 1761

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Suceava SV	10.05.1972	R. G.	R. G.	R. G.
1	Total				

Genera Rutpela Nakane et Ohbayashi 1957
33.Rutpela maculata Poda 1761

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sohodol BC	05.07.1960	G. A.	G. A.	S. R.
4	Sohodol BC	21.06.1962	G. A.	G. A.	
2	Bogdan Vodă BC	09.05.1964	G. A.	G. A.	
1	Arama SV	05.08.1969	R. G.	R. G.	
1	Valea Budului BC	12.08.1972	G. A.	G. A.	
1	Bogdan Vodă BC	09.05.1964	G. A.	G. A.	
1	Oneşti BC	07.08.1974	G. A.	G. A.	
1	Dămieneşti BC	08.06.1978	G. A.	G. A.	
1	Măgura BC	05.07.1978	A. V.	A. V.	
1	Udeşti SV	16.08.1992	P. E.	P. E.	
1	Gherăieşti BC	28.06.1993	B. D.	B. D.	
1	Valea Uzului BC	14.07.1993	P. E.	P. E.	
1	Valea Uzului BC	15.07.1993	P. E.	P. E.	
1	Valea Uzului BC	16.07.1993	H. M.	H. M.	
1	Valea Uzului BC	16.07.1993	G. A.	G. A.	
3	Valea Uzului BC	07.07.1994	P. E.	P. E.	
2	Valea Uzului BC	07.07.1994	G. A.	G. A.	
17	Valea Uzului BC	08.07.1994	P. E.	P. E.	
1	Valea Uzului BC	08.07.1994	P. C.	P. C.	
1	Valea Uzului BC	08.07.1994	C. G.	C. G.	
12	Valea Uzului BC	08.07.1994	H. M.	H. M.	
1	Sânpetru Mare TM	11.05.1995	C. M.	C. M.	
9	Slănic Moldova BC	11.06.1995	C. M.	C. M.	
3	Slănic Moldova BC	11.06.1995	H. M.	H. M.	

1	Valea Uzului BC	15.07.1995	P. E.	P. E.	
22	Valea Uzului BC	16.07.1995	G. A.	G. A.	
6	Valea Uzului BC	16.07.1995	P. C.	P. C.	
23	Valea Uzului BC	16.07.1995	P. E.	P. E.	
9	Valea Uzului BC	16.07.1995	H. M.	H. M.	
23	Valea Uzului BC	16.07.1995	C. M.	C. M.	
14	Valea Uzului BC	17.07.1995	C. M.	C. M.	
5	Valea Uzului BC	17.07.1995	P. E.	P. E.	
2	Valea Uzului BC	17.07.1995	C. G.	C. G.	
18	Valea Uzului BC	17.07.1995	H. M.	H. M.	
7	Valea Uzului BC	17.07.1995	P. V.	P. V.	
2	Valea Uzului BC	18.07.1995	C. M.	C. M.	
10	Valea Uzului BC	19.07.1995	P. E.	P. E.	
2	Valea Uzului BC	19.07.1995	H. M.	H. M.	
2	Hemeiuşi BC	01.08.1995	C. G.	C. G.	
1	Hemeiuşi BC	01.08.1995	U. C.	U. C.	
4	Slănic Moldova BC	01.08.1995	H. M.	H. M.	
1	Runc BC	04.08.1995	C. G.	C. G.	G. G.
1	Bibireşti BC	24.05.1996	G. A.	G. A.	
1	Tociloasa BC	24.05.1996	H. M.	H. M.	
1	Valea Uzului BC	04.07.1996	H. M.	H. M.	
17	Valea Uzului BC	04.07.1996	C. M.	C. M.	
20	Valea Uzului BC	05.07.1996	C. M.	C. G.	
40	Valea Uzului BC	05.07.1996	C. M.	O. J.	
10	Valea Uzului BC	05.07.1996	C. C.	C. G.	
8	Valea Uzului BC	06.07.1996	H. M.	H. M.	
2	Valea Uzului BC	06.07.1996	P. V.	P. V.	
3	Valea Uzului BC	06.07.1996	C. M.	C. M.	
83	Valea Uzului BC	07.07.1996	C. M.	C. M.	
25	Valea Uzului BC	07.07.1996	H. M.	C. G.	
1	Valea Uzului BC	08.07.1996	C. M.	C. M.	
2	Valea Uzului BC	08.07.1996	C. G.	C. G.	
1	Poiana Sărată BC	17.07.1996	H. M.	H. M.	
7	Poiana Sărată BC	17.07.1996	P. E.	P. M.	
2	Poiana Sărată BC	18.07.1996	G. A.	G. A.	
10	Poiana Sărată BC	18.07.1996	G. A.	P. M.	
15	Poiana Sărată BC	21.07.1996	H. M.	H. M.	
1	Poiana Sărată BC	21.07.1996	G. A.	G. A.	
3	Poiana Sărată BC	21.07.1996	P. E.	P. E.	
1	Poiana Sărată BC	21.07.1996	P. E.	R. S.	
2	Valea Budului BC	06.08.1996	P. E.	P. E.	
12	Gherăieşti BC	07.08.1996	P. E.	P. M.	
1	Valea Budului BC	17.06.1997	H. M.	H. M.	
1	Valea Budului BC	17.06.1997	C. M.	C. M.	
2	Valea Budului BC	04.07.1997	C. M.	C. M.	
2	Valea Uzului BC	04.07.1997	C. G.	C. G.	
1	Valea Uzului BC	05.07.1997	G. A.	G. A.	
1	Valea Uzului BC	05.07.1997	P. E.	P. E.	
1	Făget CJ	21.06.1998	H. M.	H. M.	
1	Izvorul Alb BC	21.07.1998	M. C.	M. C.	
13	Izvorul Alb BC	21.07.1998	C. M.	C. G.	
13	Valea Uzului BC	21.07.1998	C. M.	C. M.	
6	Izvorul Alb BC	22.07.1998	C. M.	C. M.	

2	Izvorul Alb BC	24.07.1998	H. M.	P. M.	
2	Izvorul Alb BC	24.07.1998	M. C.	M. C.	
1	Izvorul Alb BC	24.07.1998	H. M.	H. M.	
4	Izvorul Alb BC	24.07.1998	P. E.	G. O.	
1	Mărgineni BC	11.07.1999	P. M.	P. M.	
2	Izvorul Alb BC	24.07.1999	C. M.	C. M.	
1	Izvorul Alb BC	24.07.1999	G. G.	G. G.	
3	Izvorul Alb BC	28.07.1999	L. S.	P. M.	
5	Sărărie BC	23.06.2000	G. G.	G. G.	
1	Sărărie BC	27.06.2000	G. G.	G. G.	
2	Sărărie BC	28.06.2000	G. G.	G. G.	
1	Sărărie BC	29.06.2000	G. G.	P. M.	
1	Sărărie BC	29.06.2000	P. M.	P. M.	
10	Poiana Sărată BC	25.07.2000	J. O.	G. O.	
1	Poiana Sărată BC	25.07.2000	H. M.	G. O.	
9	Poiana Sărată BC	26.07.2000	J. O.	G. O.	
1	Vânători NT	26.07.2000	G. G.	G. O.	
1	Vânători NT	28.07.2000	G. G.	G. G.	
1	Vânători NT	28.07.2000	C. M.	C. M.	
1	Vânători NT	29.07.2000	G. G.	G. G.	
5	Agapia NT	29.07.2000	G. G.	C. L.	
9	Valea Uzului BC	08.08.2000	C. C.	G. O.	
3	Valea Uzului BC	09.08.2000	P. V.	G. O.	
1	Valea Uzului BC	09.08.2000	G. O.	G. O.	
1	Valea Uzului BC	10.08.2000	P. V.	G. O.	
9	Valea Uzului BC	11.08.2000	G. O.	G. O.	
14	Slănicel BC	28.06.2001	C. M.	C. M.	
17	Poiana Sărată BC	23.07.2001	C. M.	C. M.	
31	Poiana Sărată BC	23.07.2001	G. G.	G. O.	
16	Poiana Sărată BC	23.07.2001	P. M.	P. M.	
23	Poiana Sărată BC	23.07.2001	P. E.	P. M.	
10	Poiana Sărată BC	24.07.2001	G. G.	G. O.	
9	Poiana Sărată BC	24.07.2001	P. M.	P. M.	
13	Poiana Sărată BC	25.07.2001	P. M.	P. M.	
23	Poiana Sărată BC	25.07.2001	G. G.	G. O.	
4	Poiana Sărată BC	25.07.2001	G. G.	G. O.	
2	Poiana Sărată BC	25.07.2001	H. M.	G. O.	
13	Poiana Sărată BC	26.07.2001	G. G.	G. O.	
9	Poiana Sărată BC	26.07.2001	C. M.	C. M.	
8	Poiana Sărată BC	26.07.2001	P. M.	P. M.	
1	Poiana Sărată BC	28.07.2001	G. G.	G. O.	
4	Sărărie BC	03.06.2002	P. M.	P. M.	
4	Sărărie BC	04.06.2002	P. M.	P. M.	
1	Sărărie BC	04.06.2002	G. G.	G. G.	
22	Sărărie BC	03.07.2002	C. M.	C. M.	
1	Sărărie BC	03.07.2002	C. M.	C. M.	
3	Piatra Craiului BV	09.07.2002	G. D.	G. O.	
3	Poiana Sărată BC	22.07.2002	H. M.	H. M.	
2	Poiana Sărată BC	23.07.2002	G. G.	G. O.	
16	Poiana Sărată BC	23.07.2002	C. M.	C. M.	
4	Poiana Sărată BC	23.07.2002	P. M.	R. S.	
37	Poiana Sărată BC	24.07.2002	C. M.	C. M.	
17	Poiana Sărată BC	24.07.2002	P. M.	P. M.	

35	Poiana Sărată BC	24.07.2002	H. M.	G. O.	
8	Poiana Sărată BC	24.07.2002	G. G.	G. O.	
2	Bacău BC	25.07.2002	P. M.	P. M.	
59	Poiana Sărată BC	25.07.2002	P. M.	P. M.	
10	Poiana Sărată BC	25.07.2002	G. G.	G. O.	
13	Poiana Sărată BC	25.07.2002	H. M.	G. O.	
8	Piatra Craiului BV	07.06.2003	G. D.	P. M.	
1	Caşin BC	02.07.2003	G. G.	G. G.	
2	Piatra Craiului BV	10.07.2003	G. D.	P. M.	
1	Piatra Craiului BV	10.07.2003	G. D.	P. M.	
14	Piatra Craiului BV	21.07.2003	G. D.	P. M.	
9	Poiana Sărată BC	22.07.2003	A. M.	G. O.	
14	Poiana Sărată BC	22.07.2003	C. M.	C. M.	
10	Poiana Sărată BC	23.07.2003	C. M.	C. M.	
1	Poiana Sărată BC	23.07.2003	G. G.	G. G.	
4	Poiana Sărată BC	23.07.2003	P. E.	P. M.	
10	Poiana Sărată BC	23.07.2003	A. M.	G. O.	
23	Poiana Sărată BC	23.07.2003	A. M.	G. O.	
6	Poiana Sărată BC	25.07.2003	C. M.	C. M.	
11	Slănic Moldova BC	26.08.2003	P. M.	P. M.	
1	Slănic Moldova BC	27.08.2003	P. E.	P. M.	
1	Poiana Sărată BC	24.06.2004	G. G.	P. M.	
1	Slănic Moldova BC	26.07.2004	A. M.	G. G.	
10	Slănic Moldova BC	27.07.2004	A. M.	G. G.	
2	Slănic Moldova BC	30.07.2004	A. M.	G. G.	
1	Ceahlău NT	11.08.2004	B. T.	G. G.	
18	Sărărie BC	18.08.2004	A. M.	G. G.	
2	Sărărie BC	18.08.2004	J. O.	G. G.	
1192	Total				

Genera Stenurella Villiers 1974
34. Stenurella melanura Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Văratec NT	17.06.1962	G. A.	G. A.	G. G.
1	Valea Uzului BC	29.07.1966	G. A.	G. A.	
1	Valea Colbu SV	02.08.1966	R. G.	R. G.	R. G.
1	Arama SV	05.08.1969	R. G.	R. G.	
1	Izvorul Alb BC	06.08.1969	R. G.	R. G.	
1	Perchiu BC	06.07.1970	G. A.	G. A.	
1	Măgura BC	17.07.1970	G. A.	G. A.	
3	Gorovei SV	08.07.1971	R. G.	R. G.	
1	BerzuNTi BC	27.07.1971	G. A.	G. A.	
1	Bălătău BC	27.07.1971	G. A.	G. A.	
1	Orăşeni HG	29.07.1971	R. G.	R. G.	
1	Agapia NT	12.08.1971	R. G.	R. G.	
1	Babadag TL	14.06.1972	G. A.	G. A.	
1	Feteşti CT	27.06.1972	G. A.	G. A.	
2	Dorohoi SV	12.07.1972	R. G.	R. G.	
1	Zugreni SV	28.08.1972	R. G.	R. G.	
2	Gherăieşti BC	30.06.1973	G. A.	G. A.	G. G.
1	Valea Budului BC	17.07.1973	G. A.	G. A.	
1	Gherăieşti BC	11.07.1978	G. A.	G. A.	
2	Racova BC	26.06.1979	G. A.	G. A.	

6	Runc BC	28.06.1979	G. A.	G. A.	
1	Racova BC	28.06.1979	G. A.	G. A.	
1	Udeşti SV	16.08.1992	P. E.	P. E.	
1	Valea Uzului BC	15.07.1993	C. M.	C. M.	
1	Valea Uzului BC	15.07.1993	G. A.	G. A.	
1	Valea Uzului BC	07.07.1994	P. E.	P. E.	
1	Valea Uzului BC	07.07.1994	H. M.	H. M.	
1	Sânpetru Mare TM	11.05.1995	C. M.	C. M.	
1	Valea Uzului BC	07.07.1995	H. M.	H. M.	
1	Valea Uzului BC	15.07.1995	P. E.	P. E.	
1	Valea Uzului BC	16.07.1995	H. M.	H. M.	
1	Trebeş BC	22.07.1995	H. M.	H. M.	
1	Runc BC	04.08.1995	H. M.	H. M.	
1	Slănic Moldova BC	11.08.1995	C. M.	C. M.	
2	Buhoci BC	22.05.1996	P. E.	P. E.	
6	Bălăneşti BC	24.06.1996	P. E.	P. M.	
1	Valea Uzului BC	07.07.1996	H. M.	H. M.	
1	Valea Uzului BC	07.07.1996	C. M.	C. M.	
1	Valea Uzului BC	08.07.1996	H. M.	H. M.	
2	Poiana Sărată BC	17.07.1996	H. M.	H. M.	
7	Poiana Sărată BC	17.07.1996	H. M.	P. M.	
6	Poiana Sărată BC	19.07.1996	G. A.	P. M.	
2	Poiana Sărată BC	21.07.1996	G. A.	G. A.	
1	Valea Uzului BC	04.07.1997	C. G.	C. G.	
1	Valea Uzului BC	06.07.1997	P. E.	P. E.	
1	Poiana Sărată BC	18.07.1997	G. A.	G. A.	
2	Valea Budului BC	24.09.1997	P. E.	P. E.	
1	Valea Uzului BC	21.07.1998	C. M.	C. M.	
2	Izvorul Alb BC	23.07.1998	M. C.	M. C.	
1	Izvorul Alb BC	24.07.1999	C. M.	G. G.	
1	Izvorul Alb BC	27.07.1999	C. M.	G. G.	
1	Gherăieşti BC	01.05.2000	C.L.	C.L.	
1	Sărărie BC	23.06.2000	G. G.	G. G.	
4	Nemira BC	24.06.2000	G.G.	P.M.	
1	Sărărie BC	25.06.2000	G. G.	G. G.	
1	Sărărie BC	27.06.2000	G.G.	G.G.	
2	Sărărie BC	28.06.2000	G.G.	G.G.	
1	Vânători NT	26.07.2000	G.G.	G.O.	
3	Vânători NT	27.07.2000	G.G.	G.G.	
1	Vânători NT	28.07.2000	G.G.	G.G.	
3	Vânători NT	29.07.2000	G.G.	G.O.	
3	Vânători NT	29.07.2000	G.G.	G.G.	
1	Sărărie BC	29.06.2001	C.C.	P.M.	
5	Poiana Sărată BC	23.07.2001	G.G.	G.O.	
1	Poiana Sărată BC	25.07.2001	G.G.	G.O.	
1	Poiana Sărată BC	26.07.2001	C.M.	C.M.	
1	Poiana Sărată BC	26.07.2001	P.M.	P.M.	
2	Poiana Sărată BC	26.07.2001	G.G.	G.O.	
1	Agigea CT	27.07.2001	G.A.	P.M.	
1	Sărărie BC	03.07.2002	P.M.	P.M.	
1	Sărărie BC	03.07.2002	C.M.	G.G.	
1	Poiana Sărată BC	23.07.2002	P.M.	P.M.	
2	Poiana Sărată BC	24.07.2002	G.G.	G.O.	
1	Poiana Sărată BC	24.07.2002	P.M.	P.M.	
2	Poiana Sărată BC	27.07.2002	G.G.	G.O.	
1	Piatra Craiului BV	07.06.2003	G.D.	P.M.	
1	Piatra Craiului BV	20.06.2003	P.O.	G.G.	

1	Piatra Craiului BV	10.07.2003	G.D.	G.G.	
1	Piatra Craiului BV	21.07.2003	G.D.	P.M.	
1	Poiana Sărată BC	23.07.2003	C.M.	C.M.	
1	Poiana Sărată BC	24.07.2003	C.M.	C.M.	
4	Poiana Sărată BC	25.07.2003	C.M.	C.M.	
1	Vânători NT	22.06.2004	A.M.	G.G.	
4	Slănic Moldova BC	26.07.2004	A.M.	G.G.	
2	Slănic Moldova BC	27.07.2004	A.M.	G.G.	
2	Slănic Moldova BC	30.07.2004	A.M.	G.G.	
2	Ceahlău NT	11.08.2004	T.B.	G.G.	
3	Sărărie BC	18.08.2004	A.M.	G.G.	
2	Sărărie BC	19.08.2004	A.M.	G.G.	
149	Total				

35. Stenurella bifasciata Müller 1776

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Colibaba SV	09.07.1967	R. G.	R. G.	R. G.
1	Bijghir BC	20.04.1971	G. A.	G. A.	
1	Perchiu BC	12.05.1972	G. A.	G. A.	G. G.
3	Pietricica BC	10.07.1971	G. A.	G. A.	
2	Dorohoi SV	29.06.1972	R. G.	R. G.	R. G.
3	Valea Frumoasei BC	14.07.1972	G. A.	G. A.	
1	Valea Frumoasei BC	15.07.1972	G. A.	G. A.	
1	Balcani BC	28.07.1976	G. A.	G. A.	
1	Perchiu BC	29.07.1976	G. A.	G. A.	
1	Hemeiuşi BC	18.07.1980	G. A.	G. A.	
1	Bacău BC	26.07.1984	G. A.	G. A.	
1	Coțofăneşti BC	04.08.1984	G. A.	G. A.	
1	Hemeiuşi BC	18.07.1990	G. A.	G. A.	
5	Hemeiuşi BC	26.07.1990	G. A.	G. A.	G. G.
1	Brusturoasa BC	24.07.1991	G. A.	G. A.	
1	Valea Uzului BC	15.07.1993	G. A.	G. A.	
1	Sânpetru Mare TM	11.05.1995	C. M.	C. M.	
1	Hemeiuşi BC	05.07.1995	C. M.	C. M.	
1	Valea Uzului BC	17.07.1995	H. M.	H. M.	
1	Luncani BC	29.06.1997	F. F.	P. M.	
3	Roman NT	13.08.2003	A.M.	G.G.	
1	Başta NT	17.09.2003	A.M.	G.G.	
33	Total				

36. Stenurella nigra Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sohodol NT	01.06.1962	G. A.	G. A.	G. G.
5	Suceava SV	07.07.1964	R. G.	R. G.	R. G.
1	Răcăciuni BC	25.06.1970	G. A.	G. A.	G. G.
1	Călimani HG	17.07.1970	R. G.	R. G.	R. G.
2	Slănic Moldova BC	11.06.1971	G. A.	G. A.	G. G.
1	Slănic Moldova BC	12.06.1971	G. A.	G. A.	
1	Adâncata IŞ	16.05.1972	R. G.	R. G.	R. G.
2	Bijghir BC	18.05.1979	G. A.	G. A.	G. G.
6	Covasna CV	29.05.1982	G. A.	G. A.	

2	Covasna CV	01.06.1982	G. A.	G. A.	
3	Tociloasa BC	24.05.1996	C. C.	C. C.	
1	Tociloasa BC	27.07.1996	H. M.	H. M.	
26	Total				

37. Stenurella septempunctata Fabricius 1792

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
4	Sohodol BC	21.06.1962	G. A.	G. A.	G. G.
1	Trebeş BC	23.06.1962	G. A.	G. A.	
1	Valea Uzului BC	29.07.1966	G. A.	G. A.	
1	Bogdan-Vodă BC	09.09.1969	G. A.	G. A.	
1	Răcăciuni BC	25.06.1970	G. A.	G. A.	
1	Babadag TL	14.06.1972	G. A.	G. A.	
3	Babadag TL	12.06.1973	G. A.	G. A.	
4	Babadag TL	13.06.1973	G. A.	G. A.	
2	Babadag TL	14.06.1973	G. A.	G. A.	
4	Valea Budului BC	17.07.1973	G. A.	G. A.	
1	Gherăieşti BC	18.07.1978	G. A.	G. A.	
1	Racova BC	26.06.1979	G. A.	G. A.	
1	Valea Uzului BC	15.07.1993	C. M.	C. M.	
1	Valea Uzului BC	16.07.1993	H. M.	H. M.	
1	Bacău BC	26.07.1993	P. E.	P. E.	
1	Valea Uzului BC	05.07.1994	H. M.	H. M.	
1	Poiana Sărată BC	19.07.1996	G. A.	P. M.	
1	Vânători NT	27.07.2000	G.G.	G.G.	
1	Poiana Sărată BC	23.07.2002	P.M	P.M.	
1	Poiana Sărată BC	23.07.2002	C.M	C.M.	
32	Total				

Genera Pedostrangalia Sokolov 1897
Subgenera Etorofus Matsushita 1933
38.Pedostrangalia pubescens Fabricius 1787

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
4	Valea Uzului BC	06.07.1997	C.M.	C.M.	G.G.
1	Poiana Sărată BC	24.07.2001	G.G.	G.O.	
1	Valea Uzului BC	04.07.1997	H.M.	H.M.	
1	Poiana Sărată BC	22.07.2003	C.M.	C.M.	
1	Sărărie BC	26.06.2003	C.M.	C.M.	
8	Total				

Genera Strangalia Audinet-Serville 1835
39. Strangalia attenuata Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Botoşani BT	08.06.1964	R. G.	R. G.	G. G.
1	Dorohoi SV	29.06.1964	L. A.	L. A.	
1	Gorovei SV	17.08.1969	R. G.	R. G.	
1	Gorovei SV	31.07.1974	L. A.	L. A.	

2	M.Caşin BC	03.05.1997	C. M.	C. M.	
1	Valea Uzului BC	07.07.1997	H. M.	H. M.	
1	Valea Uzului BC	07.07.1997	C. M.	C. M.	
1	Izvorul Alb BC	22.07.1998	C.M.	P.M.	
1	Izvorul Alb BC	22.07.1998	C.M.	C.M.	
2	Dofteana BC	05.07.2002	G.G.	P.M.	
12	Total				

III. Subfamily Necydalinae
Genera Necydalis Linnaeus 1758
Subgenera Necydalis Linnaeus 1758
40. Necydalis ulmi Chevrolat 1838

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Poiana Sărată BC	24.06.2003	C.M.	C.M.	G. G.
1	Total				

IV. Subfamily Spondylinae
Tribe Asemini
Genera Arhopalus Audinet-Serville 1834
41. Arhophalus rusticus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Câmpulung SV	26.06.1968	R. G.	R. G.	G.G.
1	Valea Uzului BC	15.07.1995	P.E.	P.E.	
1	Vânători NT	27.07.2000	G.G.	G.G.	
3	Total				

Genera Tetropium Kirby 1837
42. Tetropium castaneum Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uscată HG	04.08.1978	G. A.	G. A.	G.G.
1	Vânători NT	19.07.2000	C.M.	C.M.	
2	Total				

43. Tetropium fuscum Fabricius 1787

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Piatra Craiului BV	28.06.2001	G. G.	G. G.	G.G.
1	Total				

Tribe Spondilini
Genera Spondylis Fabricius 1775
44. Spondylis buprestoides Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sărărie BC	24.06.2000	P.M.	P.M.	G.G.
1	Poiana Sărată BC	23.07.2002	C.M.	C.M.	
2	Total				

V. Subfamily Cerambycinae
Tribe Graciliini
Genera Axinopalpis Dejean 1835
45. Axinopalpis gracilis Krynicki 1832

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Bacău BC	20.07.1993	P.E.	J.O.	G.G.
1	Bacău BC	20.05.2003	G.G.	G.G.	
3	Total				

Tribe Molorchini
Genera Molorchus Fabricius 1792
46. Molorchus minor Linnaeus 1767

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Amara SV	16.05.1972	R. G.	R. G.	R. G.
1	Total				

Tribe Stenopterini
Genera Stenopterus Illiger 1804
47. Stenopterus flavicornis Küster 1846

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Băile Herculane CS	18.07.1965	R. G.	R. G.	R. G.
2	Total				

48. Stenopterus rufus Linnaeus 1767

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Văratec NT	17.06.1962	G. A.	G. A.	G. G.
1	Runc NT	14.06.1971	G. A.	G. A.	
1	Perchiu BC	17.08.1976	G. A.	G. A.	
1	Brusturoasa BC	24.07.1991	G. A.	G. A.	
1	Valea Uzului BC	14.07.1993	P. E.	P. E.	
2	Valea Uzului BC	06.07.1994	P. E.	P. E.	
2	Valea Uzului BC	06.07.1994	H. M.	H. M.	
1	Perchiu BC	27.07.1994	P. E.	P. M.	
1	Valea Uzului BC	15.07.1995	P. E.	P. E.	
2	Sărărie BC	25.06.2000	C. L.	G. G.	
1	Piatra Craiului BV	20.06.2003	P.O.	G.G.	
1	Sărărie BC	23.06.2003	C.M.	C.M.	
1	Poiana Sărată BC	22.07.2003	C.M.	H.M.	
16	Total				

Tribe Cerambycini
Genera Cerambyx Linnaeus 1758
Subgenera Cerambyx Linnaeus 1758
49. Cerambyx cerdo L.

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
5	Scutaru BC	08.08.1974	G. A.	G. A.	G.G.
1	Suceava SV	25.06.2003	R.C.	G.G.	
6	Total				

50. Cerambyx nodulosus Germ.

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Babadag TL	04.06.1972	G. A.	G. A.	R.G.
1	Total				

51. Cerambyx scopolii Füess.

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Botoşani BT	12.07.1968	R. G.	R. G.	G.G.
2	Rodna BN	17.06.1980	G. A.	G. A.	
1	Racova BC	24.06.1980	P. E.	P. E.	
1	Dospineşti BC	11.05.1980	P. E.	P. E.	
1	Valea Budului BC	28.05.1996	G. A.	G. A.	
1	Valea Uzului BC	07.07.1997	P.E.	P.E.	
1	Buhoci BC	15.05.2000	C. M.	C. M.	
1	Poiana Sărată BC	25.08.2000	H.M.	G.O.	
1	Piatra Craiului BV	24.07.2002	G.D.	G.O.	
3	Luncani BC	12.05.2003	T.B.	P.M.	
6	Luncani BC	12.05.2003	P.M.	P.M.	
4	Luncani BC	12.05.2003	R.S.	R.S.	
1	Poiana Sărată BC	22.07.2003	A.M.	G.G.	
7	Poiana Sărată BC	23.07.2003	C.M.	C.M.	
1	Căiuţi BC	30.04.2004	C.L.	C.M.	
33	Total				

Tribe Purpuricenini
Genera Purpuricenus Dejean 1821
52.Purpuricenus kaechleri Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	08.07.1994	C.G.	C.G.	G.G.
1	Sascut BC	28.06.1996	H.M.	H.M.	
1	Poiana Sărată BC	20.07.1996	P.E.	P.E.	
1	Sascut BC	17.07.1999	H. M.	H. M.	
2	Sascut BC	18.07.2005	H.M.	H.M.	
6	Total				

53. Purpuricenus budensis Götz 1783

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sascut BC	24.07.1998	H. M.	H. M.	G.G.
1	Total				

Tribe Callichromatini
Genera Aromia Audinet-Serville 1833
54. Aromia moschata Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Gorovei SV	16.07.1962	R. G.	R. G.	R. G.
1	Răchitoasa BC	15.07.1964	G. A.	G. A.	G. G.
1	Suceava SV	27.07.1967	R. G.	R. G.	R. G.

1	Durău NT	13.09.1995	P.E.	P.E.	G. G.
1	Valea Uzului BC	07.07.1996	C.M.	C.M.	
1	Valea Uzului BC	22.07.1998	C.M.	C.M.	
1	Băile Herculane CS	24.05.2002	M.A.	M.A.	
7	Total				

Tribe Rosaliini
Genera Rosalia Audinet-Serville 1833
55. Rosalia alpina Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Scutaru BC	08.08.1974	G. A.	G. A.	G. G.
1	Valea Uzului BC	07.06.1996	H.M.	C. M.	
1	Izvorul Alb BC	24.07.1998	P.M.	G. O.	
2	Izvorul Alb BC	27.07.1999	G.G.	G.G.	
1	Poiana Sărată BC	25.08.2000	H.M.	G.O.	
1	Poiana Sărată BC	22.07.2002	H.M.	H.M.	
1	Poiana Sărată BC	24.07.2002	H.M.	G.O.	
1	Piatra Craiului BV	24.07.2002	G.D.	G.O.	
1	Piatra Craiului BV	24.07.2002	R.S.	R.S.	
1	Poiana Sărată BC	26.07.2002	P.M.	P.M.	
1	Poiana Sărată BC	22.07.2003	R.S.	R.S.	
2	Poiana Sărată BC	23.07.2003	G.G.	G.G.	
2	Poiana Sărată BC	23.07.2003	C.M.	C.M.	
2	Poiana Sărată BC	23.07.2003	A.M.	G.G.	
2	Poiana Sărată BC	23.07.2003	H.M.	H.M.	
2	Poiana Sărată BC	23.07.2003	C.A.	H.M.	
2	Poiana Sărată BC	23.07.2003	A.M.	G.O.	
5	Poiana Sărată BC	23.07.2003	C.M.	C.M.	
1	Poiana Sărată BC	23.07.2003	C.A.	C.M.	
13	Poiana Sărată BC	24.07.2003	R.S.	R.S.	
2	Poiana Sărată BC	24.07.2003	H.M.	H.M.	
1	Slănic Moldova BC	30.07.2004	M.C.	G.G.	
1	Sărărie BC	19.08.2004	C.A.	H.M.	
48	Total				

Tribe Hylotrupini
Genera Hylotrupes Audinet-Serville 1834
56. Hylotrupes bajulus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
4	Gh. Gh. Dej BC	07.08.1974	G. A.	G. A.	G. G.
1	Bacău BC	01.07.1977	G. A.	G. A.	
1	Agapia NT	26.07.2000	C. M.	G. G.	
1	Poiana Sărată BC	23.07.2001	P. M.	P. M.	
1	Hemeiuşi BC	12.07.2004	C. L.	H. M.	
8	Total				

Tribe Callidiiniini
Genera Ropalopus Mulsant 1839
Subgenera Ropalopus Mulsant 1839
57. Rhopalopus clavipes Fabricius 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Bacău BC	07.07.1973	G. A.	G. A.	G. G.

1	Hemeiuşi BC	02.06.1994	D.L.	D.L.	
2	Total				

58. Rhopalopus macropus Germar 1824

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Budului	15.05.2001	C.M.	C.M.	G. G.
3	Luncani BC	12.05.2003	P.M.	P.M.	
4	Total				

Genera Callidium Mulsant 1839
59. Callidium violaceum Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Valea Uzului BC	31.07.1973	G. A.	G. A.	G. G.
1	Gherăieşti BC	23.06.1996	G. A.	G. A.	
1	Sascut BC	05.05.2001	H.M.	H.M.	
2	Piatra Craiului BV	28.06.2001	G.G.	G.G.	
1	Bacău BC	21.04.2002	G.A.	G.A.	
1	Bacău BC	05.05.2004	G.G.	G.G.	
8	Total				

Subgenera Callidiostola Reitter 1912
60. Callidium aenea Degeer 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Şandru BC	10.07.1970	G. A.	G. A.	G. G.
1	Valea Budului	28.04.1998	G.A.	G.A.	
2	Total				

Genera Phymatodes Mulsant 1839
Subgenera Phymatodes Mulsant 1839
61. Phymatodes testaceus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Adâncata IŞ	16.05.1962	R. G.	R. G.	R. G.
1	Suceava SV	21.07.1972	R. G.	R. G.	
1	Covasna CV	29.05.1982	G.A.	G.A.	G. G.
3	Bacău BC	07.06.1996	G.G.	G.G.	
1	Băbuşa VS	07.06.1997	C.C.	H.M.	
7	Total				

Tribe Anaglyptini
Genera Anaglyptus Mulsant 1839
62. Anaglyptus mysticus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Piatra Craiului BV	08.06.2001	G. D.	G. D.	G. G.
2	Total				

Tribe Clytini
Genera Plagionotus Mulsant 1842
63. Plagionotus arcuatus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Adâncata SV	16.05.1972	R. G.	R. G.	G.G.
1	Mărgineni BC	15.05.1973	G.A.	G.A.	
7	Căiuți BC	30.04.2004	C.L.	C.M.	
9	Total				

Genera Echinocerus Mulsant 1863
64. Echinocerus floralis Pallas 1733

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Adâncata SV	03.07.1967	R. G.	R. G.	R. G.
2	D.Runcului BC	14.07.1971	G. A.	G. A.	
1	Adâncata SV	16.1972	R. G.	R. G.	
1	Valea Frumoasei BC	15.07.1972	G. A.	G. A.	
1	Mărgineni BC	15.07.1973	H. M.	H. M.	
1	Racova BC	26.07.1979	G. A.	G. A.	
1	Racova BC	28.07.1979	A. V.	A. V.	
1	Sânpetru Mare TM	01.07.1995	C. M.	C. M.	G. G.
1	Holt BC	10.07.2004	A.M.	P.M.	
10	Total				

Genera Isotomus Mulsant 1863
65. Isotomus speciosus Schneider 1787

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Fălticeni SV	10.07.1977	R. G.	R. G.	G.G.
1	Filipeni BC	25.06.2003	G.G.	G.G.	
2	Total				

Genera Chlorophorus Chevrolat 1863
66. Chlorophorus herbsti Brahm 1790

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	16.07.1995	P.E.	P.E.	G.G.
1	Total				

67. Chlorophorus varius Müller 1766

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Bacău BC	27.06.1959	G. A.	G. A.	G. G.
1	Sohodol BC	22.06.1962	G. A.	G. A.	
1	Vârciorova CS	05.07.1969	R. G.	R. G.	R. G.
1	Arama IS	05.08.1969	R. G.	R. G.	
1	Gârboavele BC	05.07.1971	R. G.	R. G.	
1	Şandru BC	18.07.1971	G. A.	G. A.	G. G.

1	Onişcani BC	30.08.1971	G. A.	G. A.	
1	Coţuşca BT	15.06.1972	L. A.	L. A.	
2	Bacău BC	08.08.1972	G. A.	G. A.	
1	Dospineşti BC	16.07.1973	P. E.	P. E.	
1	Gherăieşti BC	27.08.1973	G. A.	G. A.	
1	Gherăieşti BC	13.07.1978	G. A.	G. A.	
7	Turnu Severin CS	27.07.1978	G. A.	G. A.	
1	Racova BC	08.08.1978	G. A.	G. A.	
1	Gherăieşti BC	25.08.1978	G. A.	G. A.	
2	Runc BC	28.06.1979	G. A.	G. A.	
1	Racova BC	28.06.1979	A. V.	A. V.	
1	Dospineşti BC	16.07.1983	P. E.	P. E.	
3	Gorgova TL	25.07.1984	A. V.	A. V.	
1	Hemeiuşi BC	03.08.1985	G. A.	G. A.	
1	Dospineşti BC	10.08.1986	P. E.	P. E.	
1	Hemeiuşi BC	18.07.1990	G. A.	G. A.	
1	Hemeiuşi BC	26.07.1990	G. A.	G. A.	
2	Buhuşi BC	23.07.1991	P. E.	P. E.	
1	Brusturoasa BC	24.07.1991	G. A.	G. A.	
1	Slănic Prahova PH	27.09.1991	G. A.	G. A.	
2	Valea Uzului BC	12.07.1993	P. E.	P. E.	
1	Valea Uzului BC	13.07.1993	G.A	P.M.	
1	Valea Uzului BC	08.07.1994	H.M.	H.M.	
1	Perchiu BC	27.07.1994	P. E.	P. M.	
1	Sascut BC	08.07.1995	H. M.	H. M.	
2	Gioseni BC	09.07.1995	C. M.	C. M.	
1	Dofteana BC	12.07.1995	C. M.	C. M.	
1	Perchiu BC	13.07.1995	P. E.	P. E.	
1	Sascut BC	28.06.1996	H. M.	H. M.	
1	Perchiu BC	27.07.1996	P. E.	P. E.	
1	Poiana Sărată BC	18.07.1997	G. A.	P. M.	
1	Onceşti BC	20.06.1998	P. M.	P. M.	
1	Dospineşti BC	04.07.2000	P.E.	G.O.	
1	Agapia NT	07.08.2000	G.A.	G.O.	
1	Poiana Sărată BC	24.07.2002	H.M.	H.M.	
1	Poiana Sărată BC	25.07.2003	C.M.	C.M.	
55	Total				

68. Chlorophorus figuratus Scopoli 1763

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Traian BC	07.04.1960	G. A.	G. A.	G. G.
1	Botoşani BT	18.06.1964	R. G.	R. G.	R. G.
1	Măgura BC	11.07.1970	G. A.	G. A.	G. G.
1	Gârboavele BC	25.05.1973	G. A.	G. A.	
1	Şandru BC	25.05.1973	G. A.	G. A.	
1	Perchiu BC	27.07.1994	P. E.	P. E.	
1	Gura Bărzăuţei BC	07.07.1997	H. M.	H. M.	
1	Valea Uzului BC	24.07.1998	P.M.	P.M.	
1	Dofteana BC	28.06.2000	C.M.	G.G.	
1	Gherăieşti BC	23.05.2003	H.M.	C.M.	
1	Sărărie BC	25.06.2003	G.G.	G.G.	
1	Poiana Sărată BC	23.07.2003	C.M.	H.M.	
12	Total				

69. Chlorophorus sartor Müller 1766

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Gârboavele BC	21.07.1967	R. G.	R. G.	S.R.
1	Gârboavele BC	14.07.1971	R. G.	R. G.	
3	Zărneşti BC	29.07.1971	R. G.	R. G.	
2	Dorohoi SV	26.07.1972	R. G.	R. G.	
1	Bacău BC	26.07.1974	G. A.	G. A.	
1	Răcăciuni BC	25.06.1976	G. A.	G. A.	
1	Racova BC	10.07.1978	G. A.	G. A.	
1	Runc BC	28.06.1979	A. V.	A. V.	G.G.
4	Hemeiuşi BC	25.07.1979	A. V.	A. V.	
1	Urecheşti BC	27.07.1984	G. A.	G. A.	
6	Coţofăneşti BC	04.08.1984	G. A.	G. A.	
1	Hemeiuşi BC	03.05.1985	G. A.	G. A.	
4	Buhuşi BC	23.07.1991	P. E.	P. E.	
1	Brusturoasa BC	24.07.1991	G. A.	G. A.	
2	Runc BC	29.07.1994	G. A.	P. M.	
1	Perchiu BC	13.07.1995	P. E.	P. E.	
1	Sărărie BC	28.06.2000	G.G.	G.G.	
1	Hemeiuşi BC	27.08.2000	P.V.	P.V.	
33	Total				

Genera Cyrtoclytus Ganglbauer 1881
70. Cyrtoclytus capra Germar 1824

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	08.07.1994	H. M.	H. M.	G. G.
1	Valea Uzului BC	16.07.1995	C. M.	C. M.	
4	Valea Uzului BC	16.07.1995	G. A.	G. A.	
1	Valea Uzului BC	19.07.1995	H. M.	H. M.	
1	Valea Uzului BC	19.07.1995	P. E.	P. E.	
1	Valea Uzului BC	06.07.1996	H. M.	H. M.	
2	Valea Uzului BC	06.07.1996	C. M.	C. M.	
1	Valea Uzului BC	06.07.1996	P. E.	P. E.	
1	Izvorul Alb BC	24.07.1999	C. M.	G. G.	
1	Slănicel BC	28.06.2001	C.M.	C.M.	
1	Sărărie BC	23.06.2003	C.M.	C.M.	
1	Sărărie BC	25.06.2003	G.G.	G.G.	
1	Poiana Sărată BC	23.07.2003	G.G.	G.G.	
1	Slănic Moldova BC	27.07.2004	C.M.	C.M.	
18	Total				

Genera Clytus Laicharting 1784
71. Clytus arietis Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Hemeiuşi BC	20.05.1996	P. E.	P. M.	G. G.
1	Buhoci BC	22.05.1996	C. M.	C. M.	
1	Buhoci BC	25.05.1996	P. E.	P. M.	
1	Valea Budului BC	28.04.1998	C. M.	C. M.	
1	Valea Budului BC	13.05.1998	H. M.	H. M.	
1	Valea Budului BC	17.05.2000	P. E.	P. E.	
6	Total				

72. Clytus lama Mulsant 1847

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Bacău BC	09.07.1980	G. A.	G. A.	G. G.
1	Total				

73. Clytus rhamni Germar 1817

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Răcăciuni BC	25.06.1970	G. A.	G. A.	R. G.
1	Babadag TL	04.06.1972	G. A.	G. A.	
1	Tescani BC	21.06.1972	G. A.	G. A.	
1	Gârboavele BC	27.05.1973	R. G.	R. G.	
4	Total				

VI. Subfamily Lamiinae
Tribe Mesosini
Genera Mesosa Latreille 1829
Subgenera Mesosa Latreille 1829
74. Mesosa curculionoides Linnaeus 1761

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	08.07.1994	H.M.	H.M.	G.G.
1	Hemeiuşi BC	20.05.1996	H.M.	H.M.	
1	Luncani BC	21.05.2003	R.S.	R.S.	
3	Total				

Subgenera Aphelocnemia Stephens 1831
75. Mesosa nebulosa Fabricius 1781

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Filipeni BC	30.04.2003	G.G.	G.G.	G.G.
1	Total				

Tribe Monochamini
Genera Monochamus Dejean 1821
76. Monochamus sartor Fabricius 1787

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sascut BC	25.07.1998	H. M.	H. M.	G.G.
1	Izvorul Alb BC	24.07.1999	C. M.	C. M.	
1	Izvorul Alb BC	24.07.1999	H. M.	H. M.	
1	Poiana Sărată BC	23.06.2000	G.G.	G.G.	
1	Sărărie BC	18.08.2004	R.S.	G.G.	
2	Slănic Moldova BC	07.09.2005	C.M.	C.M.	
7	Total				

Tribe Lamiini
Genera Morimus Brullè 1832
77. Morimus asper Sulzer 1776

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Tg. Ocna BC	16.06.1959	R. G.	R. G.	G.G.
1	Piteşti AG	15.07.1968	R. G.	R. G.	
3	Valea Frumoasei BC	14.07.1972	G. A.	G. A.	
3	M-ții Cocoşul SV	15.07.1975	R. G.	R. G.	
1	Racova BC	26.06.1979	A. V.	A. V.	
1	Bacău BC	01.05.1996	C.M.	C.M.	
1	Căiuți BC	28.05.2003	C.L.	H.M.	
2	Valea Budului	10.06.2003	H.M.	H.M.	
1	Poiana Sărată BC	22.07.2003	C.M.	C.M.	
1	Vaslui VS	02.08.2003	C.L.	C.M.	
1	Bacău BC	25.05.2004	G.G.	H.M.	
2	Măgura BC	22.05.2005	C.M.	C.M.	
18	Total				

Genera Lamia Fabricius 1775
78. Lamia textor Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Dospineşti BC	10.08.1986	P. E.	P. E.	G.G.
1	Zeletin BC	29.09.2002	G.G.	P.M.	
2	Bijghir BC	20.05.2002	C.L.	C.M.	
7	Roman NT	05.06.2003	A.M.	G.G.	
1	Başta NT	05.06.2003	A.M.	H.M.	
12	Total				

Tribe Dorcadionini
Genera Neodorcadion Ganglbauer 1883
79. Nedorcadion bilineatum Germar 1824

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Borsec HG	30.06.1959	G. A.	G. A.	G. G.
1	Buhoci BC	22.05.1996	C. M.	C. M.	
1	Tociloasa BC	24.05.1996	C. C.	C. C.	
1	Tociloasa BC	24.05.1996	C. G.	C. G.	
17	Tociloasa BC	24.05.1996	P. E.	P. E.	
4	Tociloasa BC	24.05.1996	G. A.	G. A.	
3	Tociloasa BC	24.05.1996	D. L.	D. L.	
6	Tociloasa BC	24.05.1996	P. C.	P. C.	
2	Perchiu BC	04.06.1996	G. A.	G. A.	
1	Tociloasa BC	27.07.1996	H. M.	H. M.	
1	Izvorul Alb BC	24.07.1999	C.M.	G.G.	
2	Buhoci BC	15.05.2000	H. M.	H. M.	
5	Roman NT	05.06.2000	A.M.	G.G.	
1	Traian BC	17.06.2003	A.M.	G.G.	
1	Hemeiuşi BC	30.06.2003	A.M.	G.G.	
3	Roman NT	13.08.2003	A.M.	G.G.	
50	Total				

Genera Dorcadion Dalman 1817
80. Dorcadion fulvum Scopoli 1763

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Călugăra BC	15.07.1959	G. A.	G. A.	S. R.
2	Sohodol BC	11.06.1961	G. A.	G. A.	
2	Ponoare MH	17.04.1968	R. G.	R. G.	R. G.
1	Dorohoi SV	08.05.1969	R. G.	R. G.	
1	Iţcani SV	08.05.1969	R. G.	R. G.	
1	Perchiu BC	12.05.1971	G. A.	G. A.	S. R.
1	Hemeiuşi BC	04.06.1972	G. A.	G. A.	
1	Luncani BC	04.06.1974	G. A.	G. A.	
1	Măgura BC	06.06.1974	G. A.	G. A.	
1	Hemeiuşi BC	07.08.1981	G. A.	G. A.	
3	Godovana BC	16.05.1994	D. L.	D. L.	G. G.
4	Godovana BC	16.05.1994	C. M.	C. M.	
9	Godovana BC	16.05.1994	H. M.	H. M.	
9	Godovana BC	16.05.1994	C. G.	C. G.	
4	Godovana BC	26.05.1994	P. E.	P. E.	
2	Glodişoare BC	16.05.1994	H.M.	H.M.	
1	Slănic Moldova BC	11.07.1995	H.M.	H.M.	
1	Tociloasa BC	24.05.1996	P.E.	P.E.	
3	Băbuşa VS	22.06.1996	C. C.	C. C.	
1	Băbuşa VS	07.06.1997	C. C.	C. C.	
1	Bistriţa BN	15.05.2002	M.D.	M.D.	
1	Bijghir BC	20.05.2002	C.L.	C.M.	
1	Luncani BC	22.05.2003	R.S.	H.M.	
2	Sohodol BC	10.05.2004	A.M.	C.M.	
3	Sohodol BC	30.05.2004	P.E.	C.M.	
57	Total				

81. Dorcadion pedestre Poda 1761

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Lacu Roşu NT	25.06.1959	G. A.	G. A.	S. R.
1	Sohodol BC	11.06.1961	G. A.	G. A.	
1	Vereşti SV	08.07.1963	R. G.	R. G.	R. G.
3	Corocăieşti SV	20.07.1963	R. G.	R. G.	S. R.
1	Bacău BC	03.05.1964	G. A.	G. A.	
1	Gorovei BT	17.08.1969	R. G.	R. G.	R. G.
1	Racova BC	31.05.1974	G. A.	G. A.	S. R.
1	Racova BC	06.06.1974	G. A.	G. A.	
1	Plopana BC	10.05.1981	R. G.	R. G.	R. G.
3	Hemeiuşi BC	28.05.1981	A. V.	A. V.	G. G.
4	Godovana BC	26.04.1993	P. E.	P. E.	
26	Godovana BC	26.04.1993	C. M.	C. M.	
3	Godovana BC	16.05.1994	C. G.	C. G.	
8	Godovana BC	16.05.1994	H. M.	H. M	
1	Godovana BC	16.05.1994	D. L.	D. L.	
1	Godovana BC	16.05.1994	G. A.	G. A.	
2	Godovana BC	16.05.1994	P. E.	P. E.	
3	Plopana BC	01.06.1994	G. A.	G. A.	
1	Godovana BC	26.06.1994	G. A.	G. A.	
1	Băbuşa VS	30.04.1995	C.C.	H.M.	
2	Băbuşa VS	20.05.1995	C. C.	C. C.	
1	Băbuşa VS	30.05.1995	C. C.	C. C.	

1	Buhoci BC	22.05.1996	G. A.	G. A.	
3	Buhoci BC	22.05.1996	C. M.	C. M.	
1	Bibireşti BC	24.05.1996	G. A.	G. A.	
8	Tociloasa BC	24.05.1996	P. C.	P. C.	
18	Tociloasa BC	24.05.1996	G. A.	G. A.	
5	Tociloasa BC	24.05.1996	D. L.	H. M.	
17	Tociloasa BC	24.05.1996	P. E.	P. E.	
2	Buhoci BC	28.05.1996	P. E.	P. E.	
2	Valea Uzului BC	08.06.1996	C. M.	C. M.	
1	Poiana Sărată BC	18.07.1996	G. A.	G. A.	
1	Tociloasa BC	24.07.1996	G. A.	G. A.	
1	Valea Budului BC	06.08.1996	C. C.	C. C.	
4	Băbuşa VS	07.06.1997	C. C.	C. C.	
1	Valea Budului BC	13.05.1998	C. G.	C. G.	
1	Hemeiuşi BC	03.06.1998	P. O.	P. O.	
1	Fântânele BC	14.05.1999	F. F.	F. F.	
1	Agapia NT	27.07.2000	C. L.	C. L.	
1	Bacău BC	24.04.2002	C.M.	C.M.	
1	Filipeni BC	04.05.2002	G.G.	H.M.	
1	Hemeiuşi BC	17.05.2002	P.M.	P.M.	
1	Hemeiuşi BC	17.05.2002	C.M.	C.M.	
2	Căiuţi BC	29.05.2003	C.L.	G.G.	
1	Traian BC	17.06.2003	A.M.	G.G.	
2	Zeletin BC	31.07.2003	A.M.	G.G.	
11	Sohodol BC	03.05.2004	P.E.	C.M.	
4	Sohodol BC	10.05.2004	A.M.	C.M.	
1	Zeletin BC	12.05.2004	Z.L.	C.M.	
1	Iaşi IS	26.05.2005	G.G.	G.G.	
161	Total				

82. Dorcadion murrayi Küster 1847

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Măgura BC	06.06.1974	G. A.	G. A.	S. R.
1	Zeletin BC	12.05.2004	Z.L.	C. M.	
2	Total				

83. Dorcadion holosericeum Krynicky 1832

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
5	Corocăieşti SV	13.07.1963	R. G.	R. G.	R. G.
5	Total				

84. Dorcadion equestre Laxmann 1770

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Măgura BC	6.06.1974	G. A.	G. A.	S. R.
1	Total				

85. Dorcadion scopolii Herbst 1784

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
2	Fântânele BC	24.05.1965	G. A.	G. A.	S. R.
2	Total				

Tribe Acanthocini
Genera Leiopus Audinet-Serville 1835
86. Leiopus nebulosus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Valea Uzului BC	20.07.1994	H.M.	H.M.	G.G.
1	Valea Budului BC	24.07.1997	P.M.	P.M.	
1	Bacău BC	20.05.2003	G.G.	G.G.	
1	Poiana Sărată BC	23.07.2003	H.M.	H.M.	
4	Total				

Tribe Tetropini
Genera Tetrops Stephens 1829
87. Tetrops praeustus Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Suceava SV	21.06.1965	R. G.	R. G.	G.G.
1	Suceava SV	06.05.1966	R. G.	R. G.	
2	Total				

Tribe Saperdini
Genera Saperda Fabricius 1775
Subgenera Saperda Fabricius 1775
88. Saperda scalaris Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Piatra Craiului BV	05.06.2001	C.M.	C.M.	G.G.
1	Sărărie BC	26.06.2003	C.M.	C.M.	
1	Humărie BC	01.08.2003	C.L.	G.O.	
3	Total				

Subgenera Compsidia Mulsant 1839
89. Saperda populnea Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sărărie BC	23.06.2003	A. M.	G. G.	G.G.
1	Total				

Tribe Phytoeciini
Genera Oberea Dejean 1835
90. Oberea oculata Linnaeus 1758

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Barați BC	07.09.1984	D.A.	D.A.	G.G.
1	Slănic Moldova BC	21.06.2004	G.A.	P.M.	
2	Total				

Genera Phytoecia Dejean 1835
Subgenera Musaria Thomson 1864
91. Phytoecia affinis Harrer 1784

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Suceava SV	21.06.1965	R. G.	R. G.	G.G.
1	Suceava SV	06.05.1966	R. G.	R. G.	

1	Luncani BC	03.06.1996	C.M.	C.M.	
1	Vânători NT	29.07.2000	G.G.	G.G.	
4	Total				

Subgenera Phytoecia Dejean 1835
92. Phytoecia pustulata Schrank 1776

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Burdujeni IS	07.06.1964	R. G.	R. G.	R. G.
1	Total				

Subgenera Opsilia Mulsant 1863
93. Phytoecia coerulescens Scopoli 1763

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sohodol BC	11.06.1961	G. A.	G. A.	S. R.
1	Total				

Tribe Agapanthiini
Genera Agapanthia Audinet-Serville 1935
94. Agapanthia dahli Richter 1821

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Sinaia BV	19.07.1964	R. G.	R. G.	R. G.
1	Total				

95. Agapanthia villossoviridescens Degeer 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Suceava SV	30.06.1968	R. G.	R. G.	R. G.
1	Todireni SV	18.06.1972	R. G.	R. G.	
1	Măgura BC	07.06.1978	A. V.	A. V.	S. R.
1	Măgura BC	05.07.1978	A. V.	A. V.	
1	Mărăşti VN	23.06.1993	H. M.	H. M.	
1	Gherăieşti BC	28.06.1993	B. D.	B. D.	
3	Hemeiuşi BC	30.05.1995	H. M.	H. M.	G. G.
1	Hemeiuşi BC	05.07.1995	H. M.	H. M.	
1	Slănic Moldova BC	11..07.1995	H. M.	H. M.	
10	Hemeiuşi BC	20.05.1996	H. M.	H. M.	
1	Hemeiuşi BC	20.05.1996	C. M.	C. M.	
2	Buhoci BC	22.051996	C. M.	C. M.	
5	Buhoci BC	22.05.1996	G. A.	G. A.	
1	Buhoci BC	22.05.1996	P. E.	P. E.	
1	Bibireşti BC	24.05.1996	G. A.	G. A.	
1	Bibireşti BC	24.05.1996	P. E.	P. E.	
2	Tociloasa BC	24.05.1996	G. A.	G. A.	
4	Tociloasa BC	24.05.1996	H. M.	H. M.	
5	Tociloasa BC	24.05.1996	C. C.	C. G.	
3	Buhoci BC	25.05.1996	P. E.	P. M.	
1	Luncani BC	03.06.1996	H. M.	H. M.	
1	Valea Uzului BC	05.07.1996	H. M.	H. M.	
1	Valea Uzului BC	05.07.1996	C. M.	C. M.	

1	Valea Uzului BC	06.07.1996	H. M.	H. M.	
1	Valea Uzului BC	05.07.1996	P. E.	P. E.	
2	Valea Uzului BC	07.07.1997	C. G.	H. M.	
2	Bibireşti BC	22.05.1998	H. M.	H. M.	
1	Fântânele BC	14.05.2000	F. F.	G. G.	
2	Buhoci BC	15.05.2000	H. M.	H. M.	
1	Valea Budului BC	15.05.2000	P. E.	P. E.	
6	Tociloasa BC	15.05.2000	C. M.	G. G.	
5	Valea Budului BC	17.05.2000	P. E.	P. E.	
1	Sărărie BC	25.06.2000	C. L.	G. G.	
1	Izvorul Alb BC	24.07.2000	C. M.	G. G.	
1	Vânători NT	27.07.2000	G. G.	G. G.	
1	Vânători NT	29.07.2000	G.G.	G.G.	
4	Valea Budului BC	15.05.2001	C.M.	C.M.	
1	Slănicel BC	28.06.2001	C.M.	C.M.	
79	Total				

96. Agapanthia violacea Fabricius 1775

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	BerzuNTi BC	25.05.1972	G. A.	G. A.	G.G.
1	Gârboavele BC	27.05.1973	R. G.	R. G.	
1	Gherăieşti BC	07.06.1977	G. A.	G. A.	
1	Racova BC	19.05.1979	G. A.	G. A.	
1	Valea Uzului BC	06.07.1994	H. M.	H. M.	
1	Buhoci BC	22.05.1996	P. E.	P. M.	
1	Buhoci BC	25.05.1996	P. E.	P. M.	
3	Hemeiuşi BC	20.06.1996	C. M.	C. M.	
1	Valea Budului BC	15.05.2000	P. O.	P. O.	
1	Valea Budului BC	13.05.2004	H.M.	H.M.	
12	Total				

97. Agapanthia leucaspis Steven 1817

no. of specimens	collecting sites	collecting data	collectors' names	preservers' names	identifiers' names
1	Adâncata SV	15.06.1968	R. G.	R. G.	S.R.
1	Total				

Results and discutions

In the studied material were identified 97 species, 69 genera, 26 tribes from 6 subfamilies of Cerambycidae family. From taxonomic point of view, the identified species are represented in graph no. 1. The Lepturinae subfamily is the best represented (36 species) followed by Cerambycidae (32 species) and Lamiinae (30 species) subfamilies.

Common species like *Rutpela maculata* (1192 specimens), *Aredolpona rubra* (296 specimens), *Carilia virginea* (262 specimens) are reprezented by a large number of specimens. Some species like *Xylosteus spinolae*, *Rhagium inquisitor, Gramoptera ruficornis*, *Paracorymbia erythroptera, Leptura aethoips*, *Necydalis ulmi, Tetropium fuscum*, *Molorchus minor, Cerambyx nodulosus, Purpuricenus budensis, Chlorophorus herbsti, Mesosa nebulosa, Dorcadion equestre, Saperda populnea, Phytoecia pustulata, Phytoecia coerulescens, Agapanthia leucaspis* are represented in our collection by one specimen.

In our colection of cerambicids are preserved rare or protected species like *Morimus asper, Cerambyx cerdo, Cerambyx nodulosus, Rosalia alpina, Leiopus nebulosus, Agapanthia leucaspis.*

We can conclude after the data analysis that the species from our collection of cerambicids represent 38% from the romanian fauna of cerambicids (256 species – Panin şi Săvulescu).

Conclusions

The analysed material comprises 3986 specimens, collected between 1969 – 2005 from 157 localities.

The catalogue presentes 97 species, 69 genera, 26 tribes from 6 subfamilies of

Cerambycidae family. The Lepturinae subfamily is best represented (36 species), followed by Cerambycinae (32 species) and Lamiinae (30 species) subfamilies.

Our colection of cerambicids preserves rare or protected species like *Morimus asper, Cerambyx cerdo, Cerambyx nodulosus, Rosalia alpina, Leiopus nebulosus, Agapanthia leucaspis.*

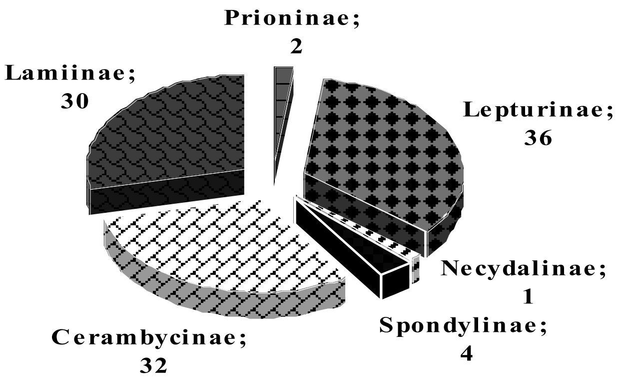
The species from our collection of cerambicids represent 38% from the romanian fauna of cerambicids (256 species – Panin şi Săvulescu).

References

1. **Danilevsky L. M.** 2003 – *Systematic list of longhorn beetles (Cerambycoidea, Coleoptera) of Europe, http://www.uochb.cas.cz/~natur /cerambyx/check_ussr3.htm;*
2. **Köhler F. und Klausnitzer B.**, 1998 – *Entomofauna Germanica Verzeichnis der Käfer Deutschlands Entomologische Nachrichten und Berichte–Beiheft 4,* Dresden; p. 131–134.
3. **Pesarini C. & Sabbadini A.,** 1994 – Natura Revista di Scienze Naturali Insetti della Fauna Europea Coleotteri Cerambicidi volume 85 fascicolo 1/2, Societa Italiana di Scienze Naturali, Milano; 133 p.
4. **Panin S., Săvulescu N.** 1961. *Fauna R.P.R. Insecta Vol. X Fasc. 5 Coleoptera Fam. Cerambycidae (Croitori),* Ed. Academiei R.P.R., Bucureşti: 523p.

Rezumat

Lucrarea prezintă colecția de cerambicide (Coleoptera, Cerambycidae) a Muzeului de Ştiințele Naturii „Ion Borcea” Bacău. Cerambicidele au fost colectate şi preparate de colectivul muzeului începând cu anul 1969, din 159 localități, iar prezentul catalog cuprinde piesele intrate în colecție începând din 1969 şi până în anul 2005 inclusiv. În colecția muzeului, familia Cerambycidae este reprezentată de 3986 indivizi ce aparțin la 97 specii.



Graph no.1 The distribution of cerambicids in the subfamilies of Cerambycidae family.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 349 – 355

THE TROPHIC SPECTRUM OF SOME CURCULIONIDAE SPECIES (COLEOPTERA: INSECTA) COLLECTED IN THE PERIOD 2001-2006 FROM NATIONAL PARK PIATRA CRAIULUI

DELIA NICOLETA GUŞĂ*

ABSTRACT

GUŞĂ D. N., 2006 - The trophic spectrum of some Curculionidae species (Coleoptera: Insecta) collected in the period 2001-2006 from National Park Piatra Craiului. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 349-355.

The biological material (entomofauna) was collected from 16 stationeries, in the period June – August between the years 2000 to 2006, along the main crest of Piatra Craiului Massif.

There were collected 1521 adults specimens of snout beetles belonging to 10 genera - *Otiorrhynchus, Phyllobius, Clorophanus, Hylobius, Miarus, Polydrosus, Peritelus, Larinus, Pissodes, Magdalis* and 34 larvae.

Key words: Curculionidae, biodiversity, National Park Piatra Craiului

Introduction

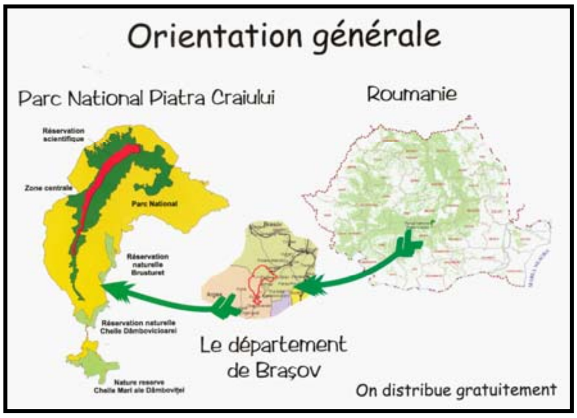
The Massif Piatra Craiului is a remarkable individualized mountain of Romanian Carpathians. The relationships established among different factors among which are geological factors, landscape, climate, hydrographical, vegetation and so on, offers to this area an unique character regarding insect fauna. Until the implementation of the program “The management of biodiversity conservation in Romania” with APNPC support the insect fauna from this region was very poorly known.

Zone description

The massif Piatra Craiului has a length of 25 km from the confluence of the river Dâmbovicioara with Dâmboviţa, near to the village Podul Dâmboviciarei, at South to Zărneşti (Barşov County) at North. It is limited by river Dâmboviţa at South and by Rucăr - Bran Pass in South – East. In the North part is bounded by the depression Ţara Bârsei out of which this mountain suddenly rise at a maximum altitude of 2235 m.

There are recorded differences regarding the vegetation on those tow main sides, the northwest part, from Bârsa Valley and Dâmboviţei Valley, and the Eastern and southeastern part from the Bran Pass. These differences are reflected in the spreading of the snout beetles species collected from 16 points (see map).

The whole massif is characterized by very abundant local precipitation on both parts which are exposed to wet air currents with relatively low temperatures along the winter.



* „Ion Borcea” Natural Sciences Museum Complex, Bacău

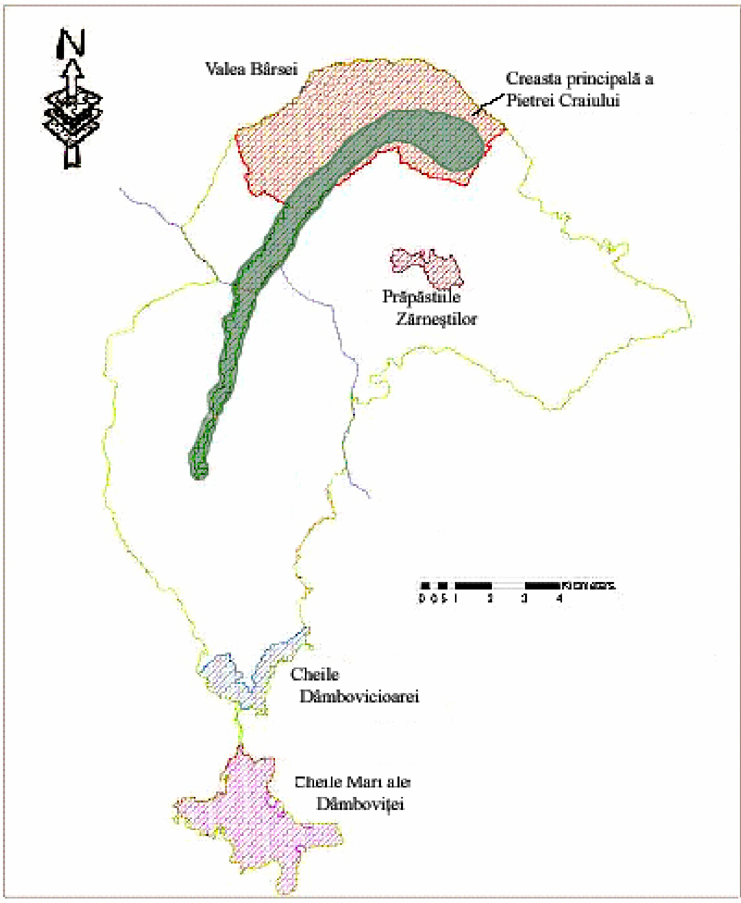


Fig. 2 - Map on the National Parc Piatra Craiului.

The biological material was collected at different altitudes including mountain vegetation situated above the superior limit of beech with some meadows followed upward by mixed stand of fir or spruce with beech. The alpine vegetation made of spruce stands which, also, include some meadow and scree vegetal associations and alpine vegetation characterized by the presence of junipers, *Rhododensron* lawns and other association among which Sesleritumurile and saxicoulous guilds prevail.

Material and methods

This paperwork concerns the species from order Coleoptera, family Curculionidae, collected in the period June – August of the years 2000-2006. There were used the following methods: vegetation sweeping with entomological net, shaking down the trees and bushes, and barber traps with 4 % formaldehyde.

The insects were identified in the laboratories of The Natural Science Museum "Ion Borcea" from Bacău, using the stereomicroscope and the identification keys for this group (see references).

The results were statistically analyzed using the diversity and ecological similarity indices for the snout beetles populations from those 16 points from National Park Piatra Craiului.

Systematic framing of Curculionidae family

The curculionidae are of curculionidae family (Superfamily Curculionoidea, Ord. Coleoptera, cls. Insecta) of insects and today amounts around 48 000 of species known all over the world (after ANDERSON, 1993-1995).

The systematic status of this great group superfamily Curculionoidea was highly discussed by most of entomologists, which study this group, at a world level. ZEHERIKHIN&EGOROV (1991) and THOMPSON (1992) tried to reorganized the system of this great group, using the determination keys in the world literature G.G. YACOBSON (1871-1926); REITTER (1908-1912); HARDE-LOHSE (1965-1976); MORRIMOTO (1962-1976), etc.

Studies of phylogeny of this superfamily were initiated by: PONOMARENKO (1969); LAWRENCE & Nexton (1982); A.G. KIREJTSUHUK (1995); KUSCHEL (1995); FARREL (1998), MARVALDI&MORRONE (2000, 2002); OBERPRIELER (2000); WANAT (2001).

During the time in Europe thorough studies have been published on a cetain kind from the Curculionidae family – the superfamily Curculionoidea works that belong to: MAGNANO, 1998 (Otiorhynchini); PIERROTTI & BELLO, 1998 (Peritelini); PODLUSSANY, 1998 (Omiini); CALDARA & O'BRIEN,1998 (Bagoinae); SÜBEN, 1999, 2003 (Cryptorhynchinae); CALDARA, 2001 (Mecini) şi COLONNELLI, 2004 (Ceutorhynchinae).

In 1999 in Barcelona in Spain a new classification appeared - „A World Catalogue of Families and Genera of Curculionoidea (Insecta: Coleoptera) (Excepting Scotylidae and Platypodidae) " authors ALONSO – ZARAZAGA M.A. şi LYAL H.C., two of the greatest specialists in Entomology membres of the Superior Council of Scientific Investigation (SCSI) in Europe, researchers within the Department of Biodiversity and Evolutionary Biology, The Museum of Natural Science in Madrid, active members of the Company– Curculio-Institute, center of studies on Europa palearctic curculionoidea (www.curci.de). These ones in cooperation with some other world well know coleopterologists currently have started a huge project to centralize the information on the number of insects but especially to elaborate a world accepted classification which should be used by entomologists all over the world.

Therefore in 1999-2004 the widest project of the European fauna took place – FAUNA EUROPEA a project finished on 7 March, 2005 upon the site-www.faunaeur.org- where the information is available and free to all interested in the study of the fauna in Europe and not only.

This project was coordinated by the University of AMSTERDAM, the University of COPENHAGA and the National Museum of History in Paris.

Fauna Europea observed the conditions imposed by the *Convention Norms of the Biological Diversity from the Europea Union Strategy on the Biological Biodiversity,* and agreed by the International Commission of Zoological Nomenclature.

This project clears up and sets a current systematis, clarification and nomenclature, used in the whole world, at present.

This sistematicalally speaking, the CURCULIONOIDEA family is part of the superfamily Curculionoidea.

The Curculionoidea superfamily currently contains 12 families Anthribidae, Apionidae, Attelabidae, Brachyceridae, Brentidae, Curculionidae, Dryophthoridae, Erirrhidae, Nanophylidae, Nemonychidae, Oxycorynidae, Raymondionymidae, Rhynchitidae.

The Curculionidae family currently contains 16 subfamilies: Bagoinae, Baridinae, Ceuthorhynchinae, Conoderinae, Cossoninae, Cryptorhynchinae, Curculioninae, Cyclominae, Entiminae, Hyperinae, Lixinae, Lesoptiliinae, Molytinae, Orobitidae, Platypodinae, Scolytinae.

Since 2002 there have been introduced as subfamilies within the Curculionoidea family, the Platipodinae and Scolytinae, which the same superfamily of Curculionoidea, for a long time.

Suprafamilia CURCULIONOIDEA

Fam. ANTHRIBIDAE
Fam APIONIDAE
Fam. ATTELABIDAE
Fam. BRACHYCERIDAE
Fam. BRENTIDAE
Fam. CURCULIONIDAE
Fam. DRYOPHTHORIDAE
Fam. ERIRHINIDAE
Fam. NANOPHYLIDAE

Sufam. Bagoinae
Subfam.Baridinae
Subfam. Ceutorhynchinae
Subfam. Conoderinae
Subfam. Cossoninae
Subfam. Cryptorhynchinae
Sufam. Curculioninae
Subfam. Cyclominae
Subfam. Entiminae
Subfam. Hyperinae
Subfam. Lixinae

Results and discussions

During 2001 – 2006 I collected in the National Park of Piatra Craiului a total of 93 species which belong to the Curculionidae family (8 subfamilies, 30 tribes and 42 gen, 1521 samples).

The Curculionidae of the regional fauna identified in the National Park of Piatra Craiului, are trophically attached to the plants from 28 families (Tab. 1); the greatest number of species populate on the plants belonging to the families: Pinacetae (19 sp.) , Betulaceae (13 sp.), Asteracea (11 sp.), Fabaceae (10 sp.), (10 sp.), Fagaceae (9 sp.) , Rosaceae (8 sp.), Plantaginaceae (7sp.), Umbeliferae (6 sp.), Malvaceae (6 sp.), Ulmaceae (4 sp.), Cruciferae, Araliaceae, Scrophulariaceae, Urticaceae (2sp.), Poaceae, Primulaceae, Graminae, Iridaceae, Euforbiaceae Polygonaceae, Lythraceae (one species) (Fig.1). Out of 93 secies of curculionidae collected, we can notice that 49 species are polyphagus (phylobiontes and xilobiontes); 23 species are olygophagous (they are fed with parts of the plants which belong to the same family); 9 are monophagous (specialised o none plant) are 10 species are stenophagous (species which are strictly specialised on an organ of a single plant, ex. *Orchestes (Salius, Rhynchaenus fagi* L.) (Fig.2).

Out of a total of 93 species of Curculionidae collected 2001-2006 in the National Park of Piatra Craiului, 49 species are polyphagous, and among these ones the best represented species are (Fig. 3);

Otiorhynchus (Nihus) scaber Linnaeus 1758, 212 samples;
Otiorhynchus (Prilisvanus) obsidianus Boheman 1843, 113 samples;
Phyllobius (Dieletus) argentatus Linnaeus 1758, 93 samples;
Phyllobius (Metaphyllobius) pomaceus Gyllenhal 1834, 65 samples; *Otiorhynchus (Prilisvanus) gemmatus Scopoli 1763,* 58 samples;
Otiorhynchus (Majetnecus) squamosus Miller 1859, 56 samples;
Larinus (Phyllonomeus) planus Fabricius 1792, 56 samples;
Polydrusus (Eudipnus) mollis Stroem 1768, 25 samples;

Out of a total of 93 species of Curculionidae collected 2001-2006 in the National Park of Piatra Craiului, 23 species are olygophagous, and among these ones the best represented species are (Fig. 4);

Hypera (Eririnomorphus) conmaculata Herbst 1795, 31 samples;
Plinthus (Plinthus) findelii Boheman 1842, 26 samples;
Brachyderes (Brachyderes) incanus Linnaeus 1758, 25 samples;
Larinus (Phyllonomeus) planus Fabricius 1792, 56 samples;
Strophosoma (Strophosoma) melanogrammum Forster 1771, 12 samples;

Out of a total of 93 species of Curculionidae collected 2001-2006 in the National Park of Piatra Craiului, 9 species are strictly monophagous, and represented species are (Fig. 5);

Barypeithes (Exomias) araneiformis Schrank 1781, 231 samples;
Polydrusus (Polydrusus) picus Fabricius 1792, 27 samples;

Out of a total of 93 species of Curculionidae collected 2001-2006 in the National Park of Piatra Craiului, 10 species are strictly stenophagous and represented species are (Fig. 5);

Orchestes (Salius) fagi Linnaeus 1758, 53 samples;
Liparus (Liparus) glabrirostris Küster 1849, 47 samples;
Hylobius (Callirus) abietis Linnaeus 1758, 7 samples;
Hypera (Hypera) viciae Gyllenhal 1813, 4 samples;

References

1. GUŞĂ D. N., 2003 - *Some systematic and ecological data regarding snout beetles fauna (Coleoptera, Curculionidae) of Piatra Craiului National Park (Braşov, country).* Research in Piatra Craiului National Park, vol.1, Edit. Phoenix
2. IONESCU A., MISCHIE G., 1991 - *Ecologie şi protecţia mediului*. Constanţa.
3. HANDREA I., 1969 - *Materialul didactic de ştiinţele naturale şi agricultură*. Ed. Didactică şi Pedagogică, Bucureşti.
4. NUSSLIN-RHUMBLER, 1922 - *Forstinsectenkunde (dritte Auflage)*, Berlin.
5. PERRIER R., 1931-1934 - *La faune de la France - Les Insectes*. Delagrave, Paris.
6. POPESCU A., SANDA V., DRĂGHICI B., 1980 - *Aspecte ale vegetatiei lemnoase din Masivul Piatra Craiului*. Contrib. bot. Cluj, 1949-160.
7. REITTER E., 1916 - *Fauna Germanica* (die Kafer). Band V, Stuttgard.
8. SANDA V., POPESCU A., 1976 - *Contribuţii la cunoaşterea vegetaţiei de stâncarii din Masivul Piatra Craiului*. Contrib. Bot., Cluj.
9. FREUDE H., HARDE KW., LOHSE GA, 1983 - Freude - Harde - Lohse: Die Käfer Mitteleuropas, Bd. 11, Curculionidae II.
10. ALONSO-ZARAZAGA M.A., LYAL CH.H.C. 1999 - *A world catalogue of families and genera of Curculionoidea (Insecta: Coleoptera) (Excepting Scolytidae and Platypodidae).* Entomopraxis. Barcelona.
11. *** www.faunaeuropea.org

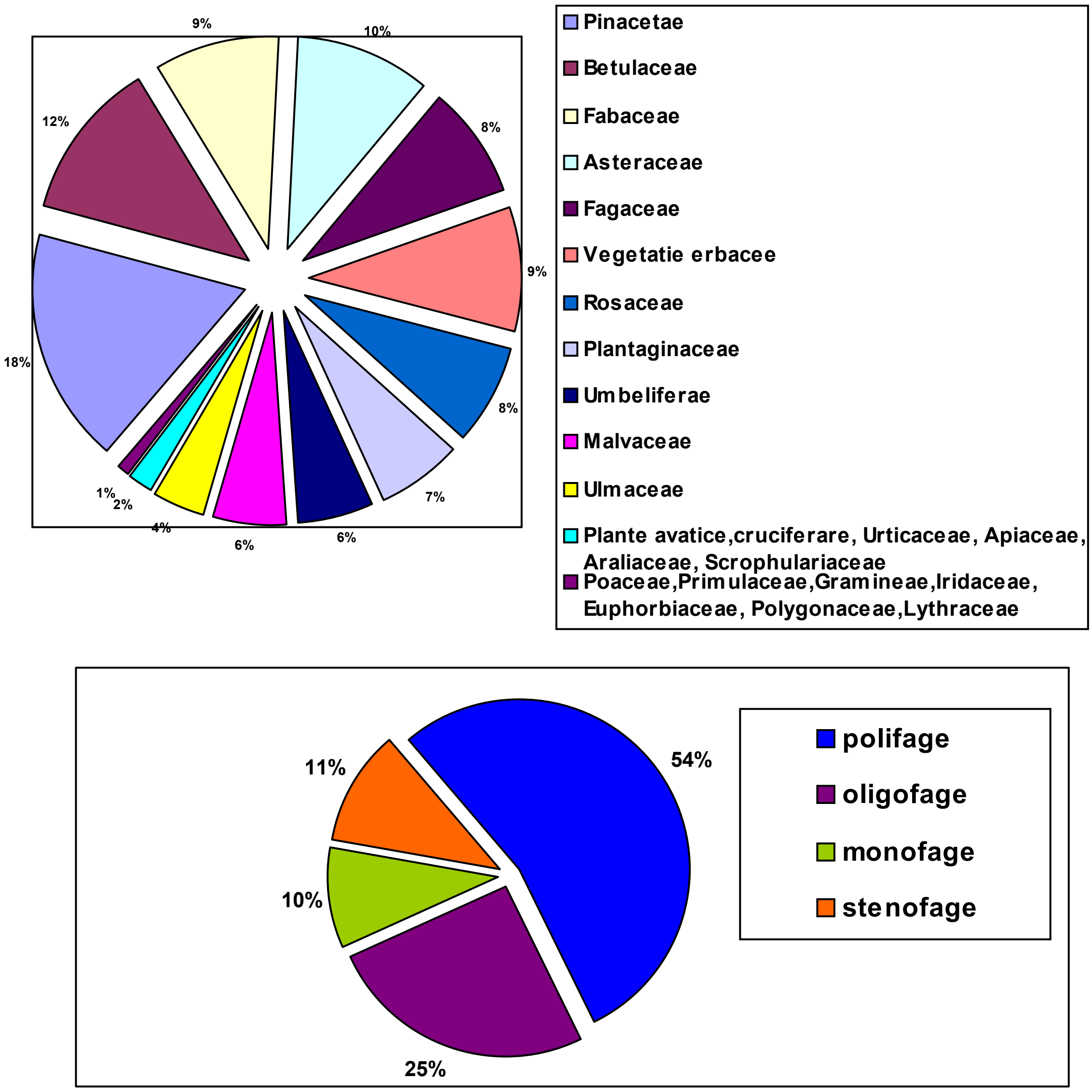


Fig.1 - The trophic spectrum of some Curculionidae species (Coleoptera-Insecta) collected in the period 2001-2006 from National Park Piatra Craiului

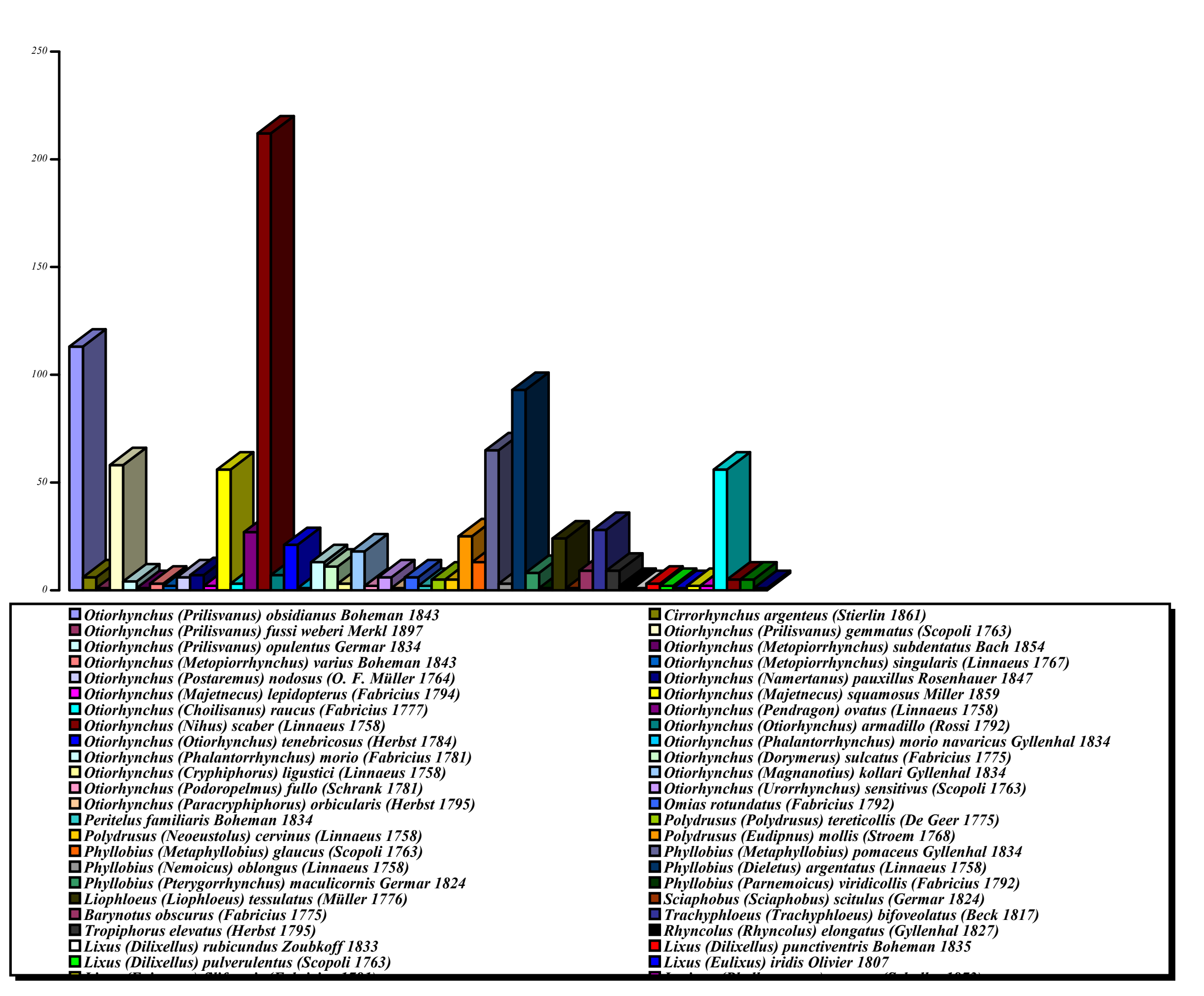


Fig 2 - Distibution of Curculionidae some trophic spectrum poliphag

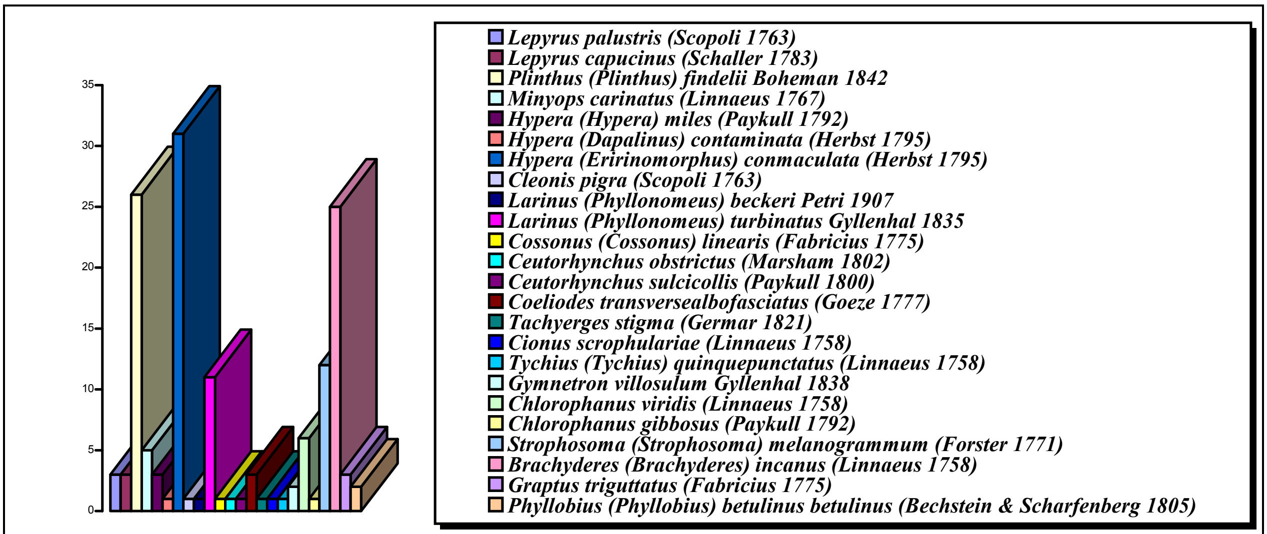


Fig. 3 - Distribution Curculionidae of the trophic spectrum oligophag.

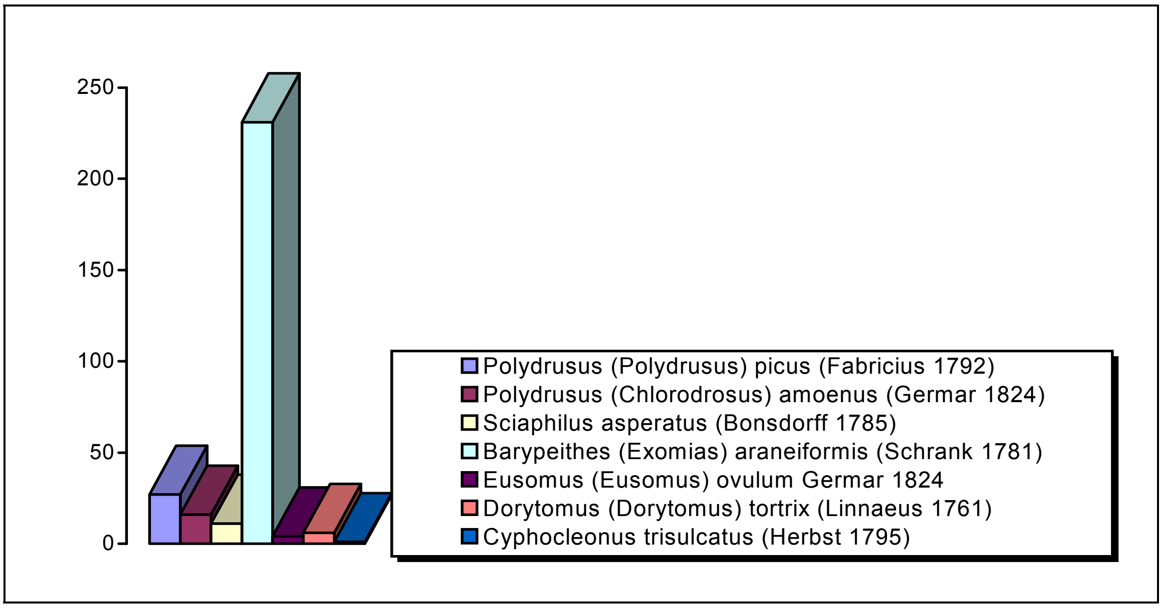


Fig. 4 - Distibution of Curculionidae some trophic spectrum monophag

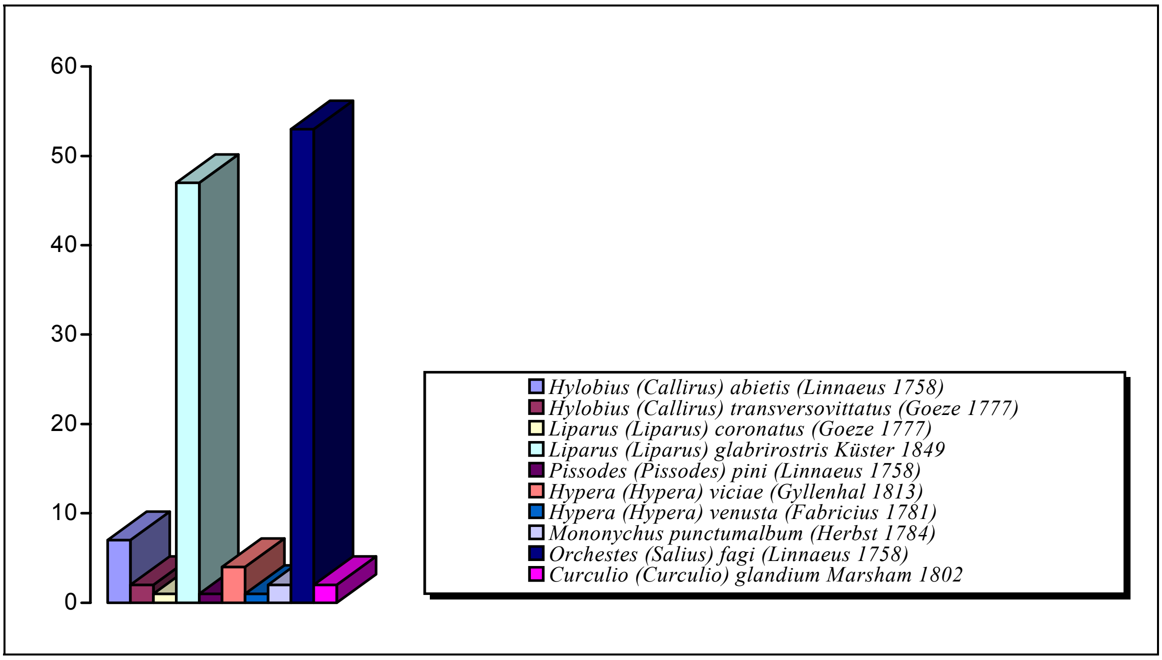


Fig 5 - Distibution of Curculionidae some trophic spectrum stenophag

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 356 – 359

NEW AND RARE ICHNEUMONIDS (HYMENOPTERA: ICHNEUMONIDAE) FOR THE FAUNA OF ROMANIA, FROM SOME NATURAL LAWN ECOSYSTEMS IN THE MOLDAVIAN PLAIN

IRINEL CONSTANTINEANU*, RAOUL CONSTANTINEANU*, CAMIL ŞTEFAN LUNGU- CONSTANTINEANU*

ABSTRACT

CONSTANTINEANU I., CONSTANTINEANU R., LUNGU- CONSTANTINEANU C. ŞT., 2006 - New and rare Ichneumonids (Hymenoptera: Ichneumonidae) for the fauna of Romania, from some natural lawn ecosystems in the Moldavian plain. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 356-359.

In this paper the authors present 15 species of Ichneumonidae belonging to 13 genera of subfamilies Banchinae, Campopleginae, Diplazontinae, Ichneumoninae, Orthocentrnae, Phaeogeninae and Tryphoninae collected from some natural lawn ecosystems in the Moldavian plain in Botoşani and Iaşi counties. The male of *Orthocentrus ambiguus* Holmgren is new in science. The species *Enizemum albopictus* Lange, *Orthocentrus ambiguus* Holmgren and *Orthocentrus fulvipes* Gravenhorst are new for the Romanian fauna and the other 12 species are rare in Romanian fauna.

Key words: ichneumonids, natural lawn, Romanian fauna

Material and methods

The authors made researches in some natural lawn ecosystems in the Moldavian Plain. They established the following stationaries: Sărata Româneşti, Botoşani county, Deleni, Vulturi, Popricani, Horleşti and “Valea lui David”, Iaşi county. Ichneumonids were collected with insect net, using sweeping (100 x) and watching methods. These ichneumonids were identified on the base of morphological characters, using the Olympus stereomicroscope.

Results and discussions

The authors present bellow the following synopsis of ichneumonid species identified in the established stationaries of some natural lawn ecosystems in the Moldavian Plain:

Family ***Ichneumonidae*** Latreille, 1802

Subfamily ***Banchinae*** Wesmael, 1845

Tribe *Glyptini* Cushman & Rohwer, 1920

I. Genus *Glypta* Gravenhorst, 1829

1. *Glypta elongata* Holmgren, 1860, ♀♂

Material: 1 ♀ and 2 ♂♂, 7. VI. 2006, Sărata Româneşti, Botoşani county, 1 ♂, 6. VI. 2006, natural reservation ”Valea lui David”, Iaşi county.

Body length = 7 – 8 mm.

Hosts: *Aphelia viburnana* Schiff., *Bactra lanceolana* Hb. (Lep., Tortricidae).

Geographycal distribution: England, Sweden, Germany, Russia, China In Romania is a rare species, being previously recorded from Bicaz, Pângăraţi, Neamţ county, Iaşi, Bârnova forest, Iaşi county, Hoceni, Vaslui county, Balta Doamnei, Prahova county, Răşinari, Sibiu county, and Sânpetru, Braşov county.

Subfamily ***Campopleginae*** Förster, 1869

II. Genus *Bathyplectes* Förster, 1869

2. *Bathyplectes curculionis* (Thomson, 1887), ♀♂

Synonyms:

1887 *Canidia curculionis* Thomson, 1887, Opusc. Ent., **11**: 1043 – 1182.

Material: 1 ♀ and 2 ♂♂, 9.V and 6. VI. 2006, Vulturi, 1 ♂, 6.VI. 2006, Horleşti, Iaşi county. Body length = 4 - 5 mm.

Hosts: *Hypera variabilis* Hbst., *Hypera murina* F. (Col., Curculionidae).

Geographycal distribution: Western Europe, U.S.A. In Romania is a rare species, being previously recorded from Suceava, Adâncata, Suceava county, Mraconia Valley, Ogradena, Dubova, Plavişeviţa, Mehedinţi county, Fundulea, Ilfov county, Caraorman, Biosphere Reserve „Danube Delta”, Tulcea county, Durău, Ceahlău,

* Biological Research Institute of Iaşi

Neamț county, Păun, Iaşi county and Ocna Dejului, Cluj county.

Subfamily ***Diplazontinae*** Viereck, 1918

III. Genus *Diplazon* Nees, 1818

3. *Diplazon annulatus* (Gravenhorst, 1829), ♀♂

Synonyms:

1829 *Bassus annulatus* Gravenhorst, Ichn. Eur., **3**: 1 – 1897;
1829 *Bassus multicolor* Gravenhorst, Ichn. Eur., **3**: 1 – 1897;
1838 *Bassus lapponicus* Zetterstedt, Ins. Lapp., **2**: 317 – 476;
1937 *Diplazon annulatus* Hellén, Not. Ent., **17**: 53.

Material: 1 ♀ and 1 ♂, 9.V and 6. VI. 2006, Vulturi, 1 ♂, 7.VI. 2006, Deleni, Iaşi county.

Body length = 5 mm.

Hosts: unknown.

Geographycal distribution: England, Finland, Sweden, Germany, Russia. In Romania is a rare species, being priviously recorded from Ineu, Arad county [A. Kiss, 1931 - 1932], Ogradena, Mehedinți county [M. Constantineanu, R. Constantineanu, 1975].

IV. Genus *Enizemum* Förster, 1869**4.**

Enizemum albopictus Lange 1911, ♂

Material: 1 ♂, 6. VI. 2006, natural reservation "Valea lui David", Iaşi county.

Body length = 5 – 6 mm.

♂. Head mat, thorax and abdomen dense and fine punctuate. Notauli absent. Areolet more or less petioled. Abdomen sessile. Tergite 2 with two short carinae.

Black. Ventral side of flagellum light brown. White are: ventral part of scapus, face, mandibles and cheeks. Mesonotum with two white spots. A white stripe under wing base. Mesopleurae are white, with a red spot at its lower part. Scutellum with white hind edge. Legs are white; hind coxae, femorae and tibiae reddish. Dorsal part of hind tibiae with a black drawing, hind tarsi entirely black. Body length = 6 mm.

Hosts: unknown.

Geographycal distribution: Germany. New species for the Romanian fauna.

Subfamily ***Ichneumoninae*** Ashmead, 1894

V. Genus *Rugosculpta* Heinrich 1967

5. *Rugosculpta gemella* Heinrich 1967, ♀♂.

Synonyms:

1829 *Ichneumon gemellus* Gravenhorst, Ichn. Eur., **1**: 201, ♂.
1893 *Barichneumon gemellus* Thomson, Opusc. Ent., **18**: 1960.

Material: 1 ♀, 21. V. 2003, Popricani, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), 1 ♂, 6. VI. 2006, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), natural reservation "Valea lui David", Iaşi county.

Body length = 9 mm.

Hosts**:** unknown.

Geographycal distribution: Europe, Russia (Ekaterinaburg). In Romania is a relative rare species, being priviously recorded from Tăşnad, Satu Mare c ounty [A. Mocsáry, 1918], Saschiz, Mureş county [A. Kiss, 1931-1932], Călian forest, Dorobanți village, Nicşeni communr, Botoşani county, Docan forest, Dimăcheni commune, Suceava county, Breazu forest, Iaşi county [M. Constantineanu, 1959].

VI. Genus *Coelichneumon* Thomson, 1893

6. *Coelichneumon dorsosignatus* Berthoumieu, 1894, ♀

Synonyms:

1916 *Amblyteles wormatiensis* Habermehl, Zeitschr. Wiess. Insektenbiol, 12: 232 – 237, 280 – 287;
1829 *Ichneumon leucocerus* Gravenhorst, Ichn. Eur., **1**: 208, ♀.

Material: 1 ♀, 21. V. 2003, Popricani, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), 1 ♀, 6. VI. 2006, natural reservation "Valea lui David", Iaşi county.

Body length: 16mm.

Hosts: unknown.

Geographycal distribution: Germany. In Romania it is a very rare species, being priviously recorded only from Iaşi county (Ciric forest and natural reservation "Valea lui David").

VII. Genus *Ctenichneumon* Thomson, 1894

7. *Ctenichneumon messorius* (Gravenhorst 1829), ♀

Material: 1 ♀, 21. V. 2003, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), Popricani and 1 ♂, 6. VI. 2006, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), natural reservation "Valea lui David", Iaşi county.

Body length: 12 mm.

Hosts: *Caradrina clavipalpis* Scop., *C. quadripunctata* F. (Lep., Noctuidae), *Aglossa pinguinalis* L. (Lep., Pyralidae), *Trichiura crataegi* L. (Lep., Lasiocampidae).

Geographycal distribution: Europe, Ukraine, Russia (Ekaterinaburg). In Romania is a rare species, being previously recorded from Codru, Bihor county [A. Kiss, 1929], Păun, Iaşi county [M. Constantineanu, 1959], Greci, Tulcea county [R. Constantineanu, Irinel Constantineanu, 1999].

VIII. Genul *Neotypus* Förster 1868

8. *Neotypus coreensis* Uchida 1930, ♂

Synonyms:

1790 *Ichneumon melanocephalus* Gmelin, Linné, Syst. Nat., 13th ed., **1**: 2687, ♀.
1829 *Ichneumon lapidator* Gravenhorst, Ichn. Eur., **1**: 628, ♀♂.
1871 *Neotypus melanocephalus* Holmgren, Ichn. Suec, **2**: 292, ♀♂.
1930 *Neotypus coreensis* Uchida, Ins. Mats., **5**: 94 – 100.

Material: 1 ♂, 21. V. 2003, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), Popricani, Iaşi county.

Body length: 10 mm.

Hosts: unknown.

Geographycal distribution: Sweden, England, Spain, France, Germany, Hungary, Russia (Tambov, Kursk). In Romania is a rare species, being previously recorded from Mehadia, Caraş-Severin county [A. Mocsáry, 1918]; Spermezeu, Bistrița-Năsăud county

[A. Kiss, 1922-1924]; Slănic MoldovaBacău county [M. Constantineanu, 1959] and Slava Rusă, Tulcea county [R. Constantineanu, Irinel Constantineanu, 1993].

Subfamily ***Orthocentrinae*** Förster, 1869

IX. Genus *Orthocentrus G*ravenhorst, 1929

9.*Orthocentrus ambiguus H***olmgren 1856, ♂**

Material: 1 ♂, 6. VI. 2006, Vulturi, Iaşi county.

♂. Head transverse. Frons plane, smooth. Antennae long as half body length. Face convex. Thorax polished. Propodeum areolate. Outer sector of radial vein almost straight. Areolet pentagonal, almost openly to outside. Nervulus oblique, interstitial, nervellus broken below the middle. Tergites 1 – 2 rugose. Tergite 1 with two weak longitudinal carinae. Gastrocoeli weakly.

Black. Yellow – reddish are: ventral side of flagellum and upper edge of face. Thorax black. Wings almost colourless, stigma brown, tegulae yellowish. Legs yellow – reddish; coxae and fore trochanters yellow. Coxae, femorae and the apex of hind tarsi more darkish. Sternum yellow. Body length = 3 - 4 mm. Male are new for Science.

Hosts: unknown.

Geographycal distribution: Sweden. New species for the Romanian fauna.

10. *Orthocentrus fulvipes* Gravenhorst 1829, ♀♂ p. 341

Material: 1 ♀, 6. VI. 2006, Horleşti, 1 ♂, 7.VI. 2006, Deleni, Iaşi county.

♀. Head little bulging. Antennae a little longer as half body length. Face a little bulging. Thorax narrower then head. Propodeum obvious areolate. Areolet a little pedicelate. Nervellus broken below the middle. Hind tarsi with rudimentary claws. Abdomen apex very little laterally compressed. Tergite 1 with two weak longitudinal carinae. Gastrocoeli to the middle of tergite 2.

Black - brown. Ventral side of flagellum reddish. Face brown, with an yellow – reddish drawing. The wings are little darkened, stigma brown, tegulae yellowish. Legs yellow – reddish, dorsal side of hind coxae usually darkened. Tergites 2 – 3 usually with hind edge red – yellow. Body length = 4.5 mm.

♂. Yellow are: palps, face, cheeks almost entirely and propleurae; coxae and hind femorae usually brown. Hind edge of tergites 2 – 3 yellow – red. Body length = 4 mm.

Hosts: *Saperda scalaria* L. (Col., Cerambycidae).

Geographycal distribution: Central and Northern Europe, Ukraine, Russia (European and Siberian parts). New species for the Romanian fauna.

Subfamily ***Phaeogeninae*** Dalla Torre, 1902

X. Genus *Diadromus* Wesmael, 1844

11. *Diadromus albinotatus* (Gravenhorst, 1829), ♀♂

Synonyms:

1829 *Ichneumon albinotatus* Gravenhorst, Ichn. Eur., **1**: 1- 827.

1859 *Diadromus albinotatus* Wesmael, Mém. Cour. Acad. Sci. Belg., **8** : 63, ♂.

Material: 1 ♀ and 2 ♂♂, 7. VI. 2006, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), Sărata Româneşti, Botoşani county, 1 ♂, 6. VI. 2006, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), natural reservation ”Valea lui David”, Iaşi county.

L. c. =5.5 – 7 mm.

Hosts: unknown.

Geographycal distribution: Suedia, Anglia, Germani. În România este o specie rară, fiind semnalată anterior de la Filioara, jud. Neamţ, Poiana Braşov, jud. Braşov [M. Constantineanu, 1965].

Subfamily ***Tryphoninae*** Shuckard, 1840

Tribe *Phytodietini* Hellén, 1915

XI. Genus *Netelia* Gray, 1860

12. *Netelia (Bessobates) virgata* (Geoffroy, 1785), ♂

Synonyms:

1785 *Ichneumon virgatus* Geoffroy, Entomologia Parisiensis, sive catalogus insectorum, quae in agro Parisiensi reperiuntur, Paris, 544 pp.

Material: 1 ♂, 6. VI. 2006, natural reservation ”Valea lui David”, Iaşi county.

Body length: ♀♀= 13 – 14 mm.; ♂♂ = 13.5 mm.

Variability: the drawing on the thorax varies between dark brown to black.

Hosts: unknown.

Geographycal distribution: Este o specie palearctică – orientală. Nordul Africii, Germania, Bosnia, Italia, Ungaria, Lituania, Bielorusia, Ucraina, Rusia (părţile europeană şi siberiană), Azerbaidjan, Armenia, Japonia. În România este o specie relativ rară, fiind semnalată anterior din munţii Retezat, jud. Hunedoara [A. Kiss, 1922 - 1924], munţii Bucegi, jud. Prahova [A. Kiss, 1931 - 1932] şi Agapia, jud. Neamţ [M. Constantineanu, 1942].

13. *Netelia (Paropheltes) thomsoni* (Brauns, 1889), ♀♂

Synonyms:

1889 *Paniscus thomsoni* Brauns, Arch. Ver. Freunde Naturgesch., Mecklenburg, **43** : 73 – 100.

Material: 1 ♀ and 1 ♂, 21. V. 2003, Popricani, 1 ♂, 7. VI. 2006. Sărata Româneşti, Botoşani county.

Body length: 10 – 11 mm.

Hosts: *Eupithecia sobrinana* Hb. şi *Eupithecia innotata* Hufn. (Lep., Geometridae).

Geographycal distribution: Central Europe, Russia (Iaroslav, Kerson). In Romania is a relative rare, being previously recorded from natural reservations “Bălteni” and ”Hârboanca”, Vaslui county [M. Constantineanu, L. Ţâţan, 1976 - 1977].

XII. Genus *Phytodietus* Gravenhorst, 1920

14. *Phytodietus (Phytodietus) ornatus* Thomson 1877, ♀

Synonyms**:**

1877 *Phytodietus rubricoxus* Thomson, Opusc. Ent., **8**: 732 – 777.

Material: 1 ♀, 7. VI. 2006, Sărata Româneşti, Botoşani county.

Body length : 10, 5 mm.

Hosts: *Parasyndesmis histrionana* Fröl., *Choristoneura murinana* Hb., *Archips rosana* L. (Lep., Tortricidae), *Anacampsis populella* Cl. (Lep., Gelechiidae) şi *Aegeria flaviventris* Strg. (Lep., Sesiidae).

Geographycal distribution: Sweden, Germany, Ukraine, Russia (St. Petersburg, Citinsk, Amursk, Novorosiisk, Kunashir islands, Sernovsk and Dubovoe). In Romania is a very rare species, being priviously recorded from Mraconia Valley, Ieşelniţa commune, Mehedinţi county [M. Constantineanu & all, 1975].

Tribul *Tryphonini* Shuckard, 1840

XIII. Genus *Neleges* Förster, 1868

15. *Neleges proditor* Gravenhorst, 1829, ♀♂

Synonyms:

1829 *Tryphon proditor* Gravenhorst, Ichn. Eur., **2**: 1-989.

1898 *Anelpistus bidentatus* Brauns, Arch. Ver. Freund. Natges. Mecklenburg, **51**: 58-72.

1903 *Tryphon bimucronatus* Strobl, Mitt. Natwiss. Ver. Steiermark, Graz, **39**: 3-100.

Material: 1 ♀, 21. V. 2003, on inflorescence of *Malaibala graveolens* Bich. (Apiaceae), Popricani, 1 ♂, 6. VI. 2006, 1 ♂, 6. VI. 2006, natural reservation "Valea lui David", Iaşi county

Hosts: unknown.

Geographycal distribution: Central and Northern Europe, Bielorusia, Russia (Iaroslav, Perm, Tiumeni). In Romania is a very rare species, being priviously recorded from Mraconia Valley, Ogradena commune, Mehedinţi county [M. Constantineanu et all, 1975] and natural reservation "Valea lui David", Iaşi county [R. Constantineanu, 1982].

Conclusions

1. In this paper the authors present 15 species belonging to 13 genera of the following subfamilies: Banchinae, Campopleginae, Diplazontinae, Ichneumoninae, Orthocentrinae, Phaeogeninae and Tryphoninae;

2. Male of *Orthocentrus ambiguus* Holmgren is new for science;

3. *Enizemum albopictus* Lange, *Orthocentrus ambiguus* Holmgren and *Orthocentrus fulvipes* Gravenhorst are new species for the Romanian fauna;

4. The other 12 species are rare for the Romanian fauna.

Rezumat

În această lucrare autorii prezintă 15 species de ihneumonide aparţinând la 13 genuri din subfamiliile Banchinae, Campopleginae, Diplazontinae, Ichneumoninae, Orthocentrnae, Phaeogeninae şi Tryphoninae colectate din unele ecosisteme praticole naturale din Câmpia Moldovei din judeţele Botoşani şi Iaşi. Masculul speciei *Orthocentrus ambiguus* Holmgren este nou pentru ştiinţă. Speciile *Enizemum albopictus* Lange, *Orthocentrus ambiguus* Holmgren şi *Orthocentrus fulvipes* Gravenhorst sunt noi pentru fauna României, iar celelalte 12 specii sunt rare în fauna României.

References

1. ATANASOV A. Z. and others, 1981 – Opredeliteli nasekomîh evropeiskoi ciasti SSSR, Pereponciatokrîlîie, Tretia ciasti (Ichneumonidae) 3 (129): 1 – 688, Leningrad.
2. DASCH C. E., 1964 – Ichneumon – Flies of America North of Mexico, 5. Subfamily Diplazontinae, Mem. Amer. Ent. Inst., 3: 1 – 304, Ann Arbor, Michigan.
3. CONSTANTINEANU M., CONSTANTINEANU R., 1971 – Contribuţii la studiul diplazontinelor (Tryphonoidae D. T., Ichneum., Hym.) din zona viitorului lac de acumulare de la Porţile de Fier (România), An. Şt. Univ. "Al. I. Cuza" Iaşi (Serie nouă), Secţ. II, a. Biol., 17 (*1*): 101 – 124.
4. CONSTANTINEANU M., CONSTANTINEANU R., 1975 – Fauna, Grupul de Cercetări Complexe "Porţile de Fier", Acad. R.S.R., Ser. Monogr., Ed. Acad. Rom., 148 – 150, Bucureşti.
5. CONSTANTINEANU R., 1972 – Contribuţii la studiul tryphonoidelor (Hym., Ichneum.) din R. S. România (Ph. D. thesis), „Al. I. Cuza" Univ. of Iaşi: a volume - text of 441 pp. and a volume with 218 figures, arranged in 94 plates.
6. KASPARZAN D. R., TOLKANITY V. I., 1999 – Ichneumonidae. Subfamily Tryphoninae: Tribes Sphinctini, Phytodietini, Oedemopsini, Tryphonini (addendum), Idiogrammatini. Subfamilies Eucerotinae, Adelognathinae (addendum), Townesioninae, Fauna of Russia and neighbouring countries, Insecta Hymenoptera, 3 (3): 1 – 404, Nauka, Saint Petersburg.
7. PISICĂ C., 2001 – Ichneumonidele (Hymenoptera, Insecta) din România şi gazdele lor – Catalog, Ed. Univ. „Al. I. Cuza" Iaşi, 406 pp.
8. TOWNES H. – The Genera of Ichneumonidae, Part 4, Mem. Amer. Ent. Inst., 17: 1 – 372, Ann Arbor, Michigan.
9. YU D. S., HORSTMANN K., 1997 – A catalogue of world Ichneumonidae (Hymenoptera), Mem. Amer. Ent. Inst., 58 (1): 1 – 763, Gainesville, Florida

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THE SYSTEMATICS AND DISTRIBUTION OF GENUS *NOMADA* (HYMENOPTERA: ANTHOPHORIDAE) IN ROMANIA

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ABSTRACT

CALEFARIU – BAN C., 2006 - The systematics and distribution of genus *Nomada* (Hymenoptera: Anthophoridae) in Romania. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 360-368.

A systematical list with 70 species of *Nomada,* reported in Romania till now is presented.

Key words: Anthophoridae, *Nomada*, systematics, distribution.

Introduction

Nomada Scop. is the only genus of tribe Nomadini. It consists of about 800 species all around the world, the abundance centre being in the Holartic region, and about 200 species in Europe. As the other cleptoparasite anthophorids, the species of this genus do not have a collecting brush and a basitibial plate, the tegument being very much sclerified and less hairy, usually red or black, with yellow or red stripes, very much similar to wasps. Most of the species are cleptoparasite in the nests of *Andrena* (Andrenidae), but some species adapted in attacking species of other families as of Melittidae, Halictidae and Anthophoridae.

The members of the *Nomadini* can be recognized by the following characters: the labrum is broader than long, the scapes of antennae are more than twice longer than broad, the paraglossae are much shorter than the first segment of the labial palpi, the maxillary palpi are three ti six segmented, the marginal cell is far larger than the pterostigma, the apex of the marginal cell is pointed or narrowly rounded, the forewings are with three or two submarginal cells, the jugal lobes of the hind wings are shorter than half length of the vannal lobes, the forecoxae are triungular, the sixth sternum of the female is subtruncated to bilobed at the apex. (Michener, 1944)

In our country there are a few comments on the genus, the most recent information dating since 1976. A number of 70 species are reported, most of them collected from Transylvania; there is no report from Moldavia. Systematical lists are given by Henrich (1880, 1883), Mocsáry (1897), Zoltán (1914), Zilahi – Kiss (1915), Móczár & Schwarz (1968), Constantinescu (1976). (Fig. 1)

The nomenclature, geographical distriburion and biological data are according to Celary (1995), Gogala (1999) and Polaszek (2005).

Abbreviations: the counties: AB – Alba, AG – Argeş, BH – Bihor, BN – Bistriţa – Năsăud, BV – Braşov, CJ – Cluj, CS – Caraş Severin, HD – Hunedoara, HR – Harghita, MH – Mehedinţi, MM – Maramureş, MS – Mureş, SB – Sibiu, SJ – Sălaj, SM – Satu Mare, TL – Tulcea.

Systematic part

Nomada Scopoli, 1770

Nomada argentata Herrich-Schäffer, 1839

Synonymies:

Nomada brevicornis Mocsáry, 1882

Faunal data from literature: Hodod (SM), Sibiu (SB), Tuşnad (HR), Mehadia (CS).

Biology. Flowers visited: Rosaceae (*Potentilla erecta*), Lamiaceae (*Stachys sp., Mentha sp*), Dipsacaceae *(Scabiosa ochroleuca),* Asteraceae (*Carduus acanthoides, Cirsium arvense).* Flying period: July – August. Host: *Andrena marginata.*

Geographical distriburion. Europe (Switzerland, Croatia, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Sweden, Denmark,

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Finland, European part of Russia: Bashkiria, Udmurtia), Asia (Georgia, Azerbaydzhan).

Nomada armata Herrich-Schäffer, 1839

Synonymies:

Nomada cincticornis Nylander, 1848

Faunal data from literature: Sibiu (SB), Reghin (MS).

Biology. Flowers visited: Dipsacaceae. Flying period: June – August. Host: *Andrena hattorfiana.*

Geographical distriburion. Europe (Spain, Italy, Croatia, Albania, Bulgaria, Romania, Ukraine, Austria, Switzerland, Bohemia, Slovakia, Germany, Belgium, the Netherlands, Graet Britain, Poland, Lithuania, Finland, Sweden, Denmark, the European part of Russia), Asia (Georgia).

Nomada atroscutellaris Strand, 1921

Synonymies:

Nomada furva var. *atroscutellaris*

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS), Ocna Dejului (CJ).

Biology. Flowers visited: Scrophulariaceae (*Veronica chamaedrys*). Flying period: May – June. Host: *Andrena viridescens.*

Geographical distriburion. Europe (Italy, Switzerland, Germany, Poland, Slovakia, Austria, Ungary, Romania), Asia Minor.

Nomada banatica

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS).

Geographical distriburion. Romania.

Nomada basalis Herrich-Schäffer, 1839

Synonymies:

Nomada flavomaculata Lucas, 1849

Faunal data from literature: Aiud (AB), Oradea (BH), Turda (CJ), Mehadia (CS), Orşova (MH), Lelei (SM), Viţa (BN).

Biology. Flying period: May – June.

Geographical distriburion. Europe (Italy, Spain, Austria, Switzerland, Bohemia, France, Greece, Hungary, Romania, Slovakia, Slovenia), Asia (Russia).

Nomada bifasciata Olivier, 1811

Synonymies:

Nomada pusilla Pérez, 1884

Nomada lepeletieri Pérez, 1884

Faunal data from literature: Mănăstirea Cocoş (TL), Bocşa (Bocşa Vasiovei, CS), Aiud (AB).

Biology. Flowers visited: Salicaceae (*Salix sp.*), Asteraceae (*Tussilago farfara, Taraxacum officinale*), Euphorbiaceae (*Euphorbia cyparissias*), Rosaceae (*Potentilla verna*). Flying period: April – May. Host: *Andrena gravida..*

Geographical distriburion. Southern and Central Europe (Italy, Spain, France, Croatia, Slovenia, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany), North Africa (Tunisia, Algeria, Marocco).

Nomada bispinosa Mocsáry, 1883

Faunal data from literature: Hodod (SM), Beclean (BN), Mehadia (CS), Reşiţa (CS), Cluj (CJ), Orşova (MS).

Biology. Flowers visited: Asteraceae (*Senecio jacobea*), Rubiaceae (Galium sp.). Flying period: May– July. Host: *Andrena sp.*.

Geographical distriburion. Europe (Spain, France, Switzerland, Italy, Croatia, Hungary, Romania, Austria, Slovakia, Poland, Germany).

Nomada blepharipes Schmiedeknecht, 1882

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS)

Biology. Flowers visited: Ranunculaceae (*Ranunculus acer)*, Umbeliferae (*Daucus carota).*

Geographical distriburion. Austria, Hungary, Romania.

Nomada blüthgeni Stoeckhert, 1943

Faunal data from literature: Orşova (MS), Cristur (HD), Nuşeni (BN).

Biology. Bivoltine, flying period: May – June and July – August. Hosts: *Lasioglossum marginellus, L. sexstrigatum.*

Geographical distriburion. Europe (Austria, Hungary, Romania), Asia (Russia).

Nomada braunsiana Schmiedeknecht, 1882

Faunal data from literature: Bocşa (Bocşa Montană, CS), Hodod (SM), Chiochiş (BN).

Biology. Flowers visited: Ranunculaceae (*Ranunculus sp.),* Scrophulariaceae (*Veronica chamaedrys*), Boraginaceae (*Anchusa officinalis).* Flying period: May– June. Hosts: *Andrena curvungula*, *A. pandellei, A. paucisquama.*

Geographical distriburion. Europe (Spain, France, Italy Croatia, Austria, Switzerland, Hungary, Romania,

Bohemia, Poland, Germany).

Nomada castellana Dusmet, 1913

Synonymies:

Nomada baeri Stoeckhert, 1930

Faunal data from literature: Rus (SJ), Aiud (AB).

Biology. Flowers visited: Asteraceae (*Solidago virgaurea*), Brassicaceae (*Sinapis arvensis*) . Flying period: May– June. Host: *Andrena semilaevis.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Hungary, Romania, Austria, Bohemia, Slovakia, Poland, Germany, Belgium, the European part of Russie).

Nomada conjungens Herrich-Schäffer, 1839

Synonymies:

Nomada dallatorreana Schmiedeknecht, 1882

Faunal data from literature: Piatra (BN), Cluj (CJ), Bocşa (Bocşa Vasiovei, CS), Băile Herculane (CS).

Biology. Flowers visited: Euphorbiaceae (*Euphorbia cyparissias*), Scrophulariaceae (*Veronica chamaedrys*), Ranunculaceae (*Ranunculus acer*), Asteraceae (*Bellis perennis*), Apiaceae (*Aegopodium podagraria*). Flying period: May – June. Host: *Andrena proxima.*

Geographical distriburion. Europa (Spain, Italy, Switzerland, Austria, Bohemia, Slovakia, Hungary, Romania, Croatia, Poland, Germany, Belgium, the Netherlands), North Africa (Algeria).

Nomada corcyraea Schmiedeknecht, 1882

Faunal data from literature: Aiud (AB).

Biology. Flying period: May – June.

Geographical distriburion. Europe (France, Greece, Italy, Spain, Romania, Hungary, the European part of Russia).

Nomada cruenta Schmiedeknecht, 1882

Faunal data from literature: Mehadia (CS).

Biology. Host: *Andrena scita.*

Geographical distriburion. Europe (Spain, Austria, Bohemia, Greece, Hungary, Romania, Slovakia, European part of Russia).

Nomada dira Schmiedeknecht, 1882

Faunal data from literature: Sibiu (SB), Strei (HD), Vița (BN).

Geographical distriburion. Europe (Greece, Spain, Italy, Hungary, Romania, the European part of Russia).

Nomada discrepans Schmiedeknecht, 1882

Faunal data from literature: Sibiu (SB), Târnăveni (MS).

Geographical distriburion. France, Italy, Slovakia, Switzerland, Romania, Hungary.

Nomada distinguenda Morawitz, 1874

Faunal data from literature: Beclean (BN), Oradea (BH), Sibiu (SB), Mehadia (CS), Orşova (MH).

Biology. Bivoltine, flying period: May – June and July – August. Host: *Lasioglossum sp.*

Geographical distriburion. Europe (Portugal, Spain, France, Switzerland, Italy, Serbia, Macedonia, Albania, Greece, Bulgaria, Romania, Hungary, Ukraine, Slovakia, Bohemia, Austria, Germany, Poland, Belgium, Olanda, Denmark, the European part of Russia), North Africa (Tunisia, Algeria), Asia (Georgia, Armenia, Afghanistan, Azerbaydzhan).

Nomada emarginata Morawitz, 1877

Faunal data from literature: Mănăstirea Cocoş (TL).

Biology. Flowers visited: Fabaceae (*Melilotus alba*), Lamiaceae (*Thymus sp.*), Dipsacaceae (*Knautia arvensis*), Astweraceae (*Hieracium pilosella).* Flying period: July – August. Host: *Melitta haemorrhoidalis.*

Geographical distriburion. Europe (Slovenia, Switzerland, Austria, Hungary, Romania, Ukraine, Bohemia, Slovakia, Belgium, the Netherlands, Germany, Poland, Lithuania, the European part of Russia), Asia (the Caucasus).

Nomada errans Lepeletier, 1841

Faunal data from literature: Ocna Dejului (CJ).

Biology. Flowers visited: Asteraceae (*Achillea millefolium, Senecio jacobea*), Apiaceae (*Daucus carota, Pastinaca sativa).* Flying period: July – August. Hosts: *Andrena nitidiuscula, A. pallitarsis.*

Geographical distriburion. Southern and Central Europe (Spain, Switzerland, Austria, Hungary, Romania, Slovakia, Bohemia, Germany, Poland).

Nomada erythrocephala Morawitz, 1871

Faunal data from literature: Beclean (BN), Bocşa (Bocşa Vasiovei, CS).

Geographical distriburion. Europe (France, Greece, Italy, Spain, European part of Russia).

Nomada fabriciana (Linnaeus, 1767)

Synonymies: *Apis fabriciana* Linnaeus, 1767

Faunal data from literature: Tihuța (BN), Mehadia (CS), Bocşa (Bocşa Vasiovei, CS), Aiud (AB).

Biology. Flowers visited: Asteraceae (*Tussilago farfara, Senecio jacobea, Centaurea jacea*), Rosaceae (*Potentilla verna, P. erecta),* Boraginaceae (*Echium vulgare*), Salicaceae (*Salix sp.).* Bivoltine, flying period: March – May and June – August. Hosts: *Andrena bicolor, A. chrysosceles.*

Geographical distriburion. Europe (Portugal, Spain, Italy, Switzerland, Austria, Hungary, Romania, Ukraine, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Sweden, the European part of Russia).

Nomada facilis Schwarz, 1967

Faunal data from literature: România (Celary, 1995).

Biology. Flowers visited: Rosaceae *(Potentilla verna*), Scrophulariaceae (*Veronica chamaedrys*), Dipsacaceae (*Knautia arvensis*), Asteraceae (*Achillea millefolium, Hieracium pilosella, Senecio vernalis*). Flying period: May – June. Hosts: *Andrena fulvago, A. Humilis.*

Geographical distriburion. Europe (Portugal, Spain, France, Italy, Switzerland, Croatia, Macedonia, Albania, Greece, Bulgaria, Romania, Hungary, Austria, Slovakia, Bohemia, Poland, Germany, the Netherlands, Great Britain, Denmark, Sweden, Finland, Lithuania, the European part of Russia), North Africa (Tunisia, Algeria), Asia (Georgia, Armenia, Azerbaydghan, the Caucasus, Israel).

Nomada femoralis Morawitz, 1869

Faunal data from literature: Orşova (MH), Văliug (CS), Bocşa (Bocşa Vasiovei, CS), Mehadia (CS), Ileanda (SJ), Câmpeni (AB).

Biology. Flowers visited: Ranunculaceae (*Ranunculus acris*), Asteraceae (*Senecio sp.*). Flying period: May -June. Hosts: *Andrena fulvago, A. humilis.*

Geographical distriburion. Europe (Spain, Sardinia, Italy, Croatia, Greece, Romania, Ukraine, Hungary, Austria, Switzerland, Germany, Bohemia, Slovakia, Poland, Lithuania, Belgium, the Netherlands), North Africa (Tunisia), Asia Minor.

Nomada ferruginata (Linnaeus, 1767)

Synonymies:

Apis xanthosticta Kirby, 1802

Nomada lateralis Panzer, 1805

Faunal data from literature: Sibiu (SB), Tihuța (BN), Braşov (BV), Mehadia (CS), Reșița (CS).

Biology. Flowers visited: Asteraceae (*Taraxacum officinale, Tussilago farfara, Hieracium sp.*), Rosaceae (*Potentilla verna*), Salicaceae (*Salix fragilis*). Flying period: April – May. Host: *Andrena praecox.*

Geographical distriburion. Europe (Spain, Switzerland, Croatia, Austria, Hungary, Romania, Ukraine, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Sweden, the European part of Russia).

Nomada flava Panzer, 1798

Synonymies:

Nomada ruficornis var. *flava* Schmiedeknecht, 1882

Faunal data from literature: Sibiu (SB), Beclean (BN), Bocşa (Bocşa Vasiovei, CS), Hodod (SM).

Biology. Flowers visited: Rosaceae (*Potentilla verna, Prunus domestica, Rubus idaeus*), Asteraceae (*Tussilago farfara, Taraxacum officinale*), Ericaceae (*Vaccinium myrtillus*), Salicaceae (*Salix caprea*). Flying period: April – May. Hosts: *Andrena nitida, A. nigroaenea..*

Geographical distriburion. Europe (Spain, Switzerland, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Swedwn, Finland, Lithuania, the European part of Russia).

Nomada flavoguttata (Kirby, 1802)

Synonymies:

Apis flavoguttata Kirby, 1802

Faunal data from literature: Sibiu (SB), Reşiţa (CS), Mehadia (CS), Orşova (MH).

Biology. Flowers visited: Salicaceae (*Salix sp.),* Euphorbiaceae (*Euphorbia cyparissias*), Rosaceae (*Potentilla arenaria, P. erecta, Fragaria vesca*), Ranunculaceae (*Ranunculus repens*), Asteraceae (*Hieracium pilosella, Tussilago farfara, Taraxacum officinale, Senecio vernalis*). Bivoltine, flying period: April – May and June– July. Hosts: *Andrena minutula, A. minutuloides, A. falsifica, A. subopaca, A. semilaevis.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Swedwn, Finland, Lithuania, the European part of Russia), North Africa (Tunisia, Algeria), Asia (Turkey, the Caucasus, Pamirs, Kazakhstan).

Nomada flavopicta (Kirby, 1802)

Synonymies:

Nomada jacobaeae auct.

Faunal data from literature: Rus (SJ), Hodod (SM), Feneş (AB), Ser (SM), Aiud (AB), Runcul Salvei (BN), Sibiu (SB), Oraviţa (CS), Mehadia (CS).

Biology. Flowers visited: Asteraceae (*Senecio jacobea, Cirsium arvensis*), Dipsacaceae (*Scabiosa ochroleuca, Knautia arvensis),*Lamiaceae (*Thymus serpyllum),*Rosaceae (*Potentilla erecta*), Fabaceae (*Melilotus alba*). Flying period: June– August. Hosts: *Melitta leporina, M. tricincta,M. nigricans, M. haemorrhoidalis.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Swedwn, Finland, Lithuania, the European part of Russia), Asia (Georgia, Kazakhstan).

Nomada fucata Panzer, 1798

Faunal data from literature: Aiud (AB), Lopodea Veche (AB), Ocna Sibiului (SB), Mănăstirea Cocoş (TL).

Biology. Flowers visited: Salicaceae (*Salix aurita*), Ranunculaceae (*Ranunculus sp.*), Lamiaceae (*Thymus serpyllum),* Asteraceae (*Taraxacum officinale, Tussilago farfara),* Rosaceae (*Potentilla arenaria, P. verna*). Bivoltine, flying period: April– May and July – August. Host: *Andrena flavipes.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Croatia, Serbia, Hungary, Romania, Ukraine, Slovakia, Bohemia, Austria, Germany, Poland, Belgium, the Netherlands, Great Britain, Albania, Greece, the European part of Russia), North Africa (Algeria, Marocco, Tunisia, Libya), Asia (Georgia, Turkmenia, Afghanistan, Pakistan, Iraq).

Nomada fulvicornis Fabricius, 1793

Synonymies:

Nomada lineola Panzer, 1798

Faunal data from literature: Bocşa (Bocşa Montană, CS), Oraviţa (CS), Mehadia (CS), Beclean (BN), Aiud (AB), Hodod (SM), Saschiz (SJ).

Biology. Flowers visited: Rosaceae (*Prunus spinosa*), Geraniaceae (*Geranium sp.*), Ericaceae (*Vaccinium vitis – idaea*), Asteraceae (*Hieracium pilosella, Taraxacum officinale* Bivoltine, flying period: April– May and July – August. Host: *Andrena carbonaria, A. bimaculata, A. tibialis.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Croatia, Serbia, Hungary, Romania, Ukraine, Slovakia,Bohemia, Austria, Germany, Poland, Belgium, the Netherlands, Great Britain, Denmark, Sweden, Finland, Lithuania, the European part of Russia), North Africa (Algeria), Asia (Georgia, Kazakhstan, Turkmenia, Japan).

Nomada furva Panzer, 1798

Faunal data from literature: Oradea (BH), Mehadia (CS), Orşova (MH), Bocşa (Bocşa Vasiovei, CS), Ileanda (SJ), Aiud (AB), Băile Herculane (CS).

Biology. Flowers visited: Rosaceae (*Fragaria vesca, Potentilla erecta),* Scrophulariaceae (*Veronica* chamaedrys), Asteraceae *(Achillea millefolium, Taraxacum officinale).* Bivoltine, flying period: May – June and July – August. Hosts: *Lasioglossum morio, L. leucopus.*

Geographical distriburion. Europe (Portugal, Spain, Italy, Croatia, Albania, Hungary, Romania, Ukraine, Slovakia, Bohemia, Austria, Switzerland, Germany, Poland, Belgium, the

Netherlands, the European part of Russia), North Africa (Algeria), Asia Minor.

Nomada furvoides Stoeckhert, 1943

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS), Orşova (MH).

Biology Bivoltine, flying period: May – June and July – August. Host: *Lasioglossum sp.*

Geographical distriburion. Europe (Romania, Slovenia, Austria).

Nomada fuscicornis Nylander, 1848

Faunal data from literature: Hodod (SM), Ileanda (SJ), Reşiţa (CS), Haţeg (HD), Ocna Dej (CJ).

Biology. Flowers visited: Asteraceae (*Leucanthemum vulgare*, *Senecio jacobea, Hieracium umbellatum, Centaurea sp., Achillea millefolium*), Lamiaceae (*Thymus sp.*), Dipsacaceae (*Scabiosa sp.*). Flying period: July– August. Host: *Panurgus calcaratus.*

Geographical distriburion. Europe (Portugal, Spain, Albania, Croatia, Switzerland, Austria Hungary, Romania, Ukraine, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Denmark, Sweden, Finland, Lithuania, the European part of Russia).

Nomada glaucopis Pérez, 1890

Faunal data from literature: Hodod (SM), Deva (HD).

Geographical distriburion. Europe (France, Italy, Sardinia, Romania, the European part of Russia).

Nomada goodeniana (Kirby, 1802)

Faunal data from literature: Beclean (BN), Hodod (SM), Saschiz (SJ), Bocşa (Bocşa Vasiovei, CS), Mehadia (CS).

Biology. Flying period: April – July. Hosts: *Andrena nigroaenea, A. nitida, A. tibialis, A. thoracica, A. cineraria.*

Geographical distriburion. Europe (Italy, Spain, Romania, Switzerland, Austria, Belgium, France, Great Britain, Finland, Bohemia, Slovenia, Slovakia, the European part of Russia), Asia (North - West Russia).

Nomada guttulata Schenck, 1861

Faunal data from literature: Bocşa (Bocşa Montană, CS).

Biology. Flowers visited: Asteraceae (*Hieracium pilosella, Taraxacum officinale, Senecio vernalis*), Scrophulariaceae (*Veronica chamaedrys*). Flying period: April – June. Hosts: *Andrena florivaga, A. labiata, A. potentillae.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany, the Netherlands, Belgium, Denmark, Great Britain, Sweden, Lithuania, the European part of Russia), Asia (Kazakhstan, Japan).

Nomada hirtipes Pérez, 1884

Faunal data from literature: Bocşa (Bocşa Montană, CS).

Biology. Flying period: April – May. Host: *Andrena sp.*

Geographical distriburion. Europe (Hungary, Romania, Slovakia, Slovenia, Austria, Germany, Belgium, Great Britain, France, the European part of Russia), Asia (Russia North – West).

Nomada hungarica Dalla Torre & Friese, 1894

Faunal data from literature: Turda (CJ).

Geographical distriburion. Europa (Hungary, Romania, France, Italy, the European part of Russia), Asia (South and Russia North – West).

Nomada incisa Schmiedeknecht, 1882

Faunal data from literature: Hodod (SM).

Biology. Flying period: May – June.

Geographical distriburion. Europe (Austria, Croatia, Hungary, Romania, Sicilia, Slovenia, the European part of Russia), Asia (Russia North – West).

Nomada integra Brullé, 1832

Synonymies:

Nomada ferruginata var. *cinctiventris* Friese, 1920

Faunal data from literature: Hodod (SM), Târnăveni (MS), Odorhei (HR).

Biology. Flowers visited: Rosaceae (*Potentilla verna*), Asteraceae (*Senecio vernalis, Knautia arvensis*), Scrophulariaceae (*Veronica chamaedrys*). Flying period: May – June. Hosts: *Andrena fulvago, A. humilis.*

Geographical distriburion. Europe (Portugal, Spain, France, Switzerland, Italy, Croatia, Macedonia, Albania, Greece, Bulgaria, Romania, Hungary, Austria, Slovakia, Bohemia, Poland, Germany, the Netherlands, Great Britain, Denmark, Sweden, Finland, Lithuania, Latvia, the European part of Russia), North Africa (Tunisia, Algeria), Asia (Georgia, Armenia, Israel, the Caucasus).

Nomada kohli Schmiedeknecht, 1882

Faunal data from literature: Beclean (BN), Hodod (SM), Corund (SM), Oradea (BH), Bocşa (Bocşa Vasiovei, CS).

Biology. Bivoltine, flying period: April – June and July – August. Host: *Lasioglossum sp.*

Geographical distriburion. Europe (Romania, Hungary, Slovenia, Slovakia, Bohemia, Austria, Germany, Switzerland, France, Italy, Spain, the European part of Russia), Asia (Russia North – West).

Nomada lathburiana (Kirby, 1802)

Synonymies:

Apis lathburiana Kirby, 1802

Apis rufiventris Kirby, 1802

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS), Aiud (AB), Cristur (HD).

Biology. Flowers visited: Salicaceae (*Salix bicolor, S. aurita*), Asteraceae (*Tussilago farfara*). Flying period: April – June. Hosts: *Andrena cineraria, A. vaga.*

Geographical distriburion. Europe (Italy, Spain, Croatia, Elveția, Romania, Hungary, Austria, Germany, Poland, the Netherlands, Belgium, Ukraine, Bohemia, Slovakia, Denmark, Sweden, Finland, Latvia, the European part of Russia), Asia (Georgia, Armenia).

Nomada leucophtalma (Kirby, 1802)

Synonymies:

Nomada borealis Zetterstedt, 1838

Faunal data from literature: Romania (Celary, 1995).

Biology. Flowers visited: Salicaceae, Asteraceae. Flying period: April – May. Host: *Andrena clarkella.*

Geographical distriburion. North and Central Europe (Switzerland, Austria, Hungary, Romania, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Sweden, Finland, Lithuania).

Nomada marshamella (Kirby, 1802)

Synonymies:

Nomada alternata plur. auct. nec (Kirby)

Faunal data from literature: Seci (AG).

Biology. Flowers visited: Rosaceae, Ranunculaceae (*Ranunculus sp.*), Euphorbiaceae (*Euphorbia cyparissias*), Asteraceae (*Bellis perennis, Taraxacum officinale*), Salicaceae. Bivoltine, flying period: April – May and June–August. Hosts: *Andrena bimaculata, A. assimilis, A. nitida, A. nigroaenea, A. rosae.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Croatia, Bulgaria, Romania, Hungary, Austria, Bohemia, Slovakia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark, Sweden, Finland, Latvia, the European part of Russia).

Nomada mauritanica Lepeletier, 1841

Faunal data from literature: Beclean (BN), Sibiu (SB), Bocşa (Bocşa Vasiovei, CS), Hodod (SM).

Geographical distriburion. Europe (Croatia, Bohemia, France, Italy, Spain, Sardinia, Sicilia, Hungary, Romania, the European part of Russia), North Africa.

Nomada melanopyga Schmiedeknecht, 1882

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS), Hodod (SM), Zalău (SJ), Şuncuiuş (BH), Ocna Dej (CJ), Aiud (AB).

Geographical distriburion. Europe (Austria, Slovakia, Hungary, Romania, the European part of Russia).

Nomada mocsáry Schmiedeknecht, 1882

Faunal data from literature: Jibou (SJ).

Geographical distriburion. Europe (Francew, Italy, Spain, Hungary, Romania, Slovakia, the European part of Russia), Asia.

Nomada mutabilis F. Morawitz, 1870

Faunal data from literature: Haţeg (HD), Mehadia (CS).

Biology. Flowers visited: Salicaceae, Scrophulariaceae (*Veronica chamaedrys*), Lamiaceae (*Thymus serpyllum*), Asteraceae. Flying period: May – June. Host: *Andrena labialis.*

Geographical distriburion. Europe (Spain, Italy, Croatia, Switzerland, Austria, Hungary, Romania, Ukraine, Slovakia, Bohemia, Poland, Lithuania, Germany, Belgium, the Netherlands, the European part of Russia); Asia (Turkey, Georgia, Turkmenia, Nepal).

Nomada mutica Morawitz, 1872

Faunal data from literature: Mehadia (CS), Viţa (BN).

Biology. Flying period: April – June. Host: *Andrena sp.*

Geographical distriburion. Europe (Italy, Austria, Belgium, Bohemia, France, Germany, Hungary, Romania, Slovakia, Slovenia, Spain, Switzerland, the Netherlands, the European part of Russia).

Nomada nobilis Herrich-Schäffer, 1839

Faunal data from literature: Mănăstirea Cocoş (TL), Saschiz (SJ), Băile Herculane (CS).

Biology. Flowers visited: Rosaceae (*Crataegus sp.*), Lamiaceae (*Thymus sp.*). Flying period: May – July. Host: *Andrena nasuta.*

Geographical distriburion. Europe (Spain, Switzerland, Italy, Slovenia, Croatia, Serbia, Albania, Greece, Romania, Hungary, Austria, Bohemia, Slovakia, Poland, the European part of Russia), North Africa (Algeria), Asia (Israel).

Nomada obtusifrons Nylander, 1848

Faunal data from literature: Tuşnad (HR), Tihuţa (BN).

Biology. Flowers visited: Rosaceae, Asteraceae (*Cirsium arvense, Solidago virgaurea),* Lamiaceae (*Mentha sp., Thymus sp.*)*,* Geraniaceae (*Geranium pratense*)*.* Flying period: July – August. Host: *Andrena sp.*

Geographical distriburion. Slovenia (Alpi), Switzerland (Alpi), Austria, Germany, Bohemia, Slovakia (Carpaţi), Poland, Hungary, Romania (Carpaţi), the European part of Russia, Great Britain, Belgium, Denmark, Sweden, Finland.

Nomada ochrostoma Zetterstedt, 1838

Synonymies:

Nomada alboguttata Herrich-Schäffer, 1839

Nomada quinquespinosa Thomson, 1870

Faunal data from literature: Hodod (SM), Bocşa (Bocşa Montană, CS)

Biology. Flowers visited: Asteraceae, Rosaceae. Bivoltine, flying period: April – May and June – August. Host: *Andrena barbilabris.*

Geographical distriburion. Europe (Spain, Italy, Switzerland, Serbia, Hungary, Romania Ukraine, Austria, Germany, Bohemia, Slovakia, Poland, Great Britain, Belgium, Denmark, the Netherlands, the European part of Russia), Asia (Georgia, Japan, Kamchatka).

Nomada panzeri Lepeletier, 1841

Synonymies:
Nomada glabella Thomson, 1870
Nomada ruficornis plur. auct. nec Linnaeus; Schmiedeknecht, 1882.

Faunal data from literature: Beclean (BN), Mehadia (CS), Bocşa (Bocşa Vasiovei, CS), Hodod (SM), Tuşnad (HR), Saschiz (SJ), Zalău (SJ), Orăştie (HD), Cehul Silvaniei (SJ).

Biology. Flowers visited: Salicaceae, Rosaceae, Asteraceae, Brassicaceae, Ericaceae (*Vaccinium myrtillus, V. Vitis – idaea*), Scrophulariaceae. Flying period: April – June. Hosts: *Andrena lapponica, A. varians, A. fucata.*

Geographical distriburion. Europe (Portugal, Spain, Croatia, Switzerland, Austria, Hungary, Romania, Ukraine, Germany, Bohemia, Slovakia, Poland, Great Britain, Belgium, Denmark, Sweden, the Netherlands, Finland, Lithuania, the European part of Russia), Africa de Nord (Algeria), Asia (Georgia, Japonia, Kamchatka).

Nomada pectoralis Morawitz, 1878

Faunal data from literature: Oradea (BH), Viţa (BN).

Geographical distriburion. Europe (Romania, France, Spain, the European part of Russia), Asia (Russia North - West).

Nomada piccioliana Magretti, 1883

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS).

Geographical distriburion. Europe (Romania, Austria, Belgium, Bohemia, France, Germany, Italy, Spain, Slovakia, Switzerland).

Nomada pulchra Arnold, 1888

Faunal data from literature: Saschiz (SJ).

Geographical distriburion. Europe (Romania, Austria, France, Germany, Lithuania, the European part of Russia).

Nomada rhenana Morawitz, 1872

Faunal data from literature: Aiud (AB), Tuşnad (HR).

Biology. Flowers visited: Asteraceae (*Tanacetum vulgare, Solidago sp.*), Fabaceae (*Medicago sativa*), Lamiaceae (*Thymus sp.).* Specie bivoltină, flying period: May – June and July– August. Host: *Andrena ovatula.*

Geographical distriburion. Europe (Spain, France, Switzerland, Italy, Slovenia, Croatia, Greece, Bulgaria, Romania, Hungary, Ukraine, Slovakia, Bohemia, Austria, Germany, Belgium, the Netherlands, Poland, Lithuania, the European part of Russia), Africa de Nord (Algeria, Marocco).

Nomada roberjeotiana Panzer, 1799

Synonymies:
Nomadita montana Mocsáry, 1894
Nomada roberjeotiana ssp. *tormentillae* Alfken, 1901

Faunal data from literature: Romania (Celary, 1995).

Biology. Flowers visited: Asteraceae, Dipsacaceae, Fabaceae, Apiaceae (*Daucus carota*). Flying period: July– August. Host: *Andrena coitana.*

Geographical distriburion. Europe (Austria, Switzerland, Croatia, Hungary, Romania, Ukraine, Slovakia, Bohemia, Germany, Poland, Great Britain, Belgium, the Netherlands, Danemarca, Latvia, Finland, Sweden, the European part of Russia).

Nomada rostrata Herrich-Schäffer, 1839

Faunal data from literature: Mehadia (CS).

Geographical distriburion. Europe (Romania, Austria,Bohemia, Germany, Hungary, Lithuania, Slovakia).

Nomada ruficornis (Linnaeus, 1758)

Synonymies:
Apis ruficornis Linnaeus, 1758
Nomada bifida Thomson, 1872

Faunal data from literature: Zalău (SJ), Mănăstirea Cocoş (TL), Mănăstirea Celic (TL), Oraviţa (CS), Bocşa (Bocşa Vasiovei, CS), Saschiz (SJ).

Biology. Flowers visited: Ranunculaceae (*Anemone nemorosa, Ranunculus sp.*), Rosaceae (*Fragaria vesca, Potentilla erecta, Prunus spinosa*), Geraniaceae (*Geranium silvaticum*), Ericaceae (*Vacciunium sp.),* Boraginaceae *(Myosotis sp.).* Flying period: April– May. Host: *Andrena haemorrhoa.*

Geographical distriburion. Europe (Spain, Italy, Austria, Switzerland, Hungary, Romania, Ukraine, Slovakia, Bohemia, Poland, Germany, the Netherlands, Belgium, Great Britain, Denmark, Sweden, Finland, the European part of Russia).

Nomada rufipes Fabricius, 1793

Synonymies:
Nomada solidaginis Panzer, 1799

Faunal data from literature: Transilvania.

Biology. Flowers visited: Rosaceae, Asteraceae (*Hieracium sp., Solidago sp., Senecio jacobea, Centaurea scabiosa*). Flying period: July – August. Host: *Andrena fuscipes.*

Geographical distriburion. Europe (Spain, Italy, Austria, Switzerland, Hungary, Romania, Ukraine, Slovakia, Slovakia, Bohemia, Poland, Germany, the Netherlands, Belgium, Great Britain, Denmark, Lithuania, Finland, the European part of Russia), Africa de Nord (Algeria).

Nomada sexfasciata Panzer, 1799

Faunal data from literature: Aiud (AB), Oradea (BH), Şura Mare (SB), Sibiu (SB), Sighişoara (MS), Mehadia (CS).

Biology. Flowers visited: Salicaceae (*Salix sp.)*, Asteraceae (*Senecio vernalis, Taraxacum officinale, Hieracium sp.*), Boraginaceae (*Pulmonaria sp.*). Bivoltine, flying period: May – June and July – August. Hosts: *Eucera longicornis, E. tuberculata.*

Geographical distriburion. Europe (Portugal, Spain, Italy, Bulgaria, Hungary, Romania, Ukraine, Slovakia, Bohemia, Poland, Germany, Sweden, Belgium, the Netherlands, Great Britain, Lithuania, the European part of Russia), North Africa (Algeria, Marocco).

Nomada sheppardana (Kirby, 1802)

Synonymies:

Nomada dalii Curtis, 1832

Nomada minuscula Noskiewicz, 1930

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS).

Biology. Flowers visited: Asteraceae (*Bellis perennis*), Caryophyllaceae (*Stellaria holostea*). Bivoltine, flying period: May – June and July – August. Host: *Lasioglossum nitidiusculum.*

Geographical distriburion. Europe (France, Switzerland, Italy, Greece, Romania, Hungary, Austria, Slovakia, Bohemia, Poland, Germany Belgium, the Netherlands, Great Britain, the European part of Russia), North Africa (Tunisia, Algeria, Marocco).

Nomada signata Jurine, 1807

Faunal data from literature: Bocşa (Bocşa Vasiovei, CS), Hodod (SM), Aiud (AB).

Biology. Flowers visited: Salicaceae, Rosaceae, Asteraceae (*Hieracium sp*.), Ericaceae (*Vaccinium myrtillus*). Flying period: April – May. Host: *Andrena fulva.*

Geographical distriburion. Europe (Spain, Switzerland, Croatia, Romania, Hungary, Austria, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Great Britain, Denmark).

Nomada similis Morawitz, 1872

Faunal data from literature: Ileanda (SJ), Bocşa (Bocşa Montană, CS), Tihuța (BN)

Biology. Flowers visited: Rosaceae, Asteraceae. Flying period: July– August. Host: *Panurgus sp.*

Geographical distriburion. Europe (Romania, Spain, Albania, Switzerland, Austria, Slovakia, Bohemia, Poland, Germany, Belgium, the Netherlands, Sweden, the European part of Russia).

Nomada stigma Fabricius, 1804

Synonymies:

Nomada cinnaberina Morawitz, 1870

Faunal data from literature: Turda (CJ), Cluj (CJ), Tihuța (BN), Hodod (SM), Aiud (AB), Braşov (BV).

Biology. Flowers visited: Brassicaceae (*Brassica napus*), Rosaceae, Asteraceae (*Hieracium sp., Senecio sp., Taraxacum officinale*). Flying period: July – August. Hosts: *Andrena humilis, A. decipiens, A. labialis, A. schencki, A. taraxaci.*

Geographical distriburion. Europa (Spain, Switzerland, Italy, Croatia, Romania, Hungary, Ukraine, Slovakia, Bohemia, Austria, Poland, Germany, Belgium, Sweden, Finland, the European part of Russia), North Africa (Algeria), Asia (Cyprus, Turkey, Kazakhstan).

Nomada striata Fabricius, 1793

Faunal data from literature: Munții Rodnei (MM), Oradea (BH), Mehadia (CS), Reşița (CS), Giuleşti MM), Bocşa (Bocşa Vasiovei, CS), Saschiz (SJ), Seci (AG), Nuşeni (BN), Aiud (AB).

Biology. Flowers visited: Ranunculaceae, Asteraceae, Dipsacaceae, Ericaceae. Flying period: May – July. Hosts: *Andrena similis, A. intermedia.*

Geographical distriburion. Europe (Spain, Italy, Croatia, Romania, Hungary, Ukraine, Slovakia, Austria, Bohemia, Poland, Germany, the Netherlands, Belgium, Great Britain, Denmark, Sweden, Finland, the European part of Russia), Asia (Cyprus, the Caucasus).

Nomada succincta Panzer, 1798

Faunal data from literature: Aiud (AB), Mehadia (CS), Tihuța (BN), Cluj (CJ).

Biology. Flowers visited: Salicaceae, Rosaceae, Euphorbiaceae, Asteraceae. Flying period: April – June. Hosts: *Andrena nigroaenea, A. nitida..*

Geographical distriburion. Europe (Portugal, Spain, Italy, Croatia, Switzerland, Serbia, Romania, Hungary, Ukraine, Slovakia, Bohemia, Austria, Poland, Germany, the Netherlands, Belgium, Great Britain, Denmark, Sweden, Finland, Latvia the European part of Russia), North Africa (Algeria).

Nomada trispinosa Schmiedeknecht, 1882

Faunal data from literature: Aiud (AB), Câmpeni (AB), câmpia Transilvaniei.

Biology. Flowers visited: Euphorbiaceae, Lamiaceae. Flying period: May – July. Hosts: *Andrena humilis, A. taraxaci.*

Geographical distriburion. South and Central Europe (Slovenia, Croatia, Serbia, Bulgaria, Romania, Hungary, Ukraine, Slovakia, Bohemia, Austria, Poland), Asia (Cyprus).

Nomada verna Schmiedeknecht, 1882

Faunal data from literature: Aiud (AB).

Biology. Flying period: March – May. Host: *Andrena sp.*

Geographical distriburion. Europe (Romania, Hungary, Slovenia, Austria, Croatia, Bohemia, Italy, the European part of Russia), Asia.

Nomada zonata Panzer, 1798

Faunal data from literature: Reşița (CS), Bocşa (Bocşa Vasiovei, CS), Saschiz (SJ).

Biology. Flowers visited: Salicaceae, Rosaceae, Lamiaceae, Asteraceae. Bivoltine, flying period: April – May and July – August. Host: *Andrena dorsata.*

Geographical distriburion. Europe (Spain, France, Italy, Switzerland, Croatia, Austria, Romania, Hungary, Slovenia, Slovakia, Bohemia, Poland, Germany, Belgium, the European part of Russia), North Africa (Marocco), Asia (Turkey, Turkestan, Turkmenia).

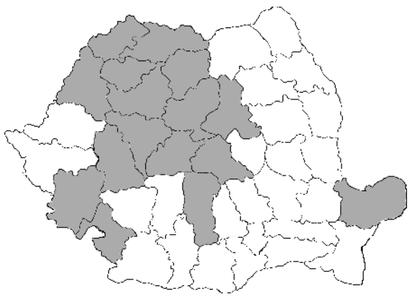

Fig.1 – The map of the areas where *Nomada* species were reported, from literature.

Discussion

Nomada banatica is a doubtful status species in the fauna of our country, its single report belonging to Zilahi – Kiss (1915). For the confirmation of this species in Banat (Bocşa, Romania) it is necessary to resume the studies within this area. Because of the lack of information from literature regarding this species it might be the possibility of a wrong identification.

Nomada leucophtalma and *Nomada roberjeotiana* are reported by Celary (1995) as present in Romania.

Rezumat

În lucrare sunt prezentate 70 specii din genul *Nomada* semnalate până în prezent în România. *Nomada banatica* este o specie cu statut incert în fauna ţării noastre, singura semnalare a speciei aparţinând lui Zilahi – Kiss (1915). Majoritatea speciilor citate provin din Transilvania; nu există semnalări din Moldova. Lista mai cuprinde date de biologie şi distribuţie. Pentru realizarea listei de specii a fost necesară reactualizarea nomenclaturii şi a localităţilor.

References

1. CELARY W., 1995 - *Nomadini* (*Hymenoptera, Apoidea, Anthophoridae) of Poland,* Monografie Fauny Polski, Polska Akademia Nauk, 20: 281.
2. CONSTANTINESCU A., 1976 - *Ordinul Hymenoptera, Apoidea (Fam. Colletidae, Halictidae, Melittidae, Megachilidae et Apidae) in l`Entomofauna du Nord de la Dobrogea, la Zone Măcin-Tulcea-Niculiţel*, Travaux du Muséum d`Histoire Naturelle "Grigore Antipa", 17: 153-157.
3. GOGALA A., 1999 - *Bee Fauna of Slovenia: Checklist of Species (Hymenoptera: Apoidea)*, Scopolia, Slovenia Museum of Natural History, Ljubljana, 42:1-79.
4. HENRICH C., 1880 - *Verzeichniss der im Jahre 1879-1883 bei Hermannstadt beobachteten Blumennwespen (Anthophila),* Verh. Mitt. siebenb. Ver. Naturiw. Hermannstadt, 30: 179-182.
5. HENRICH C., 1883 - *Verzeichniss der im Jahre 1879-1883 bei Hermannstadt beobachteten Blumennwespen (Anthophila),* Verh. Mitt. siebenb. Ver. Naturiw. Hermannstadt, 33: 115-116.
6. MICHENER C., D., 1944 - *Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera).* Bulletin of the American Museum of Natural History, 82 (6): 175 pp.
7. MOCSÁRY AL, 1897 - *Arthropoda, Ord. Hymenoptera*, Fauna Regni Hungarie, Regia Societas Scientiarum Naturalium Hungarica, Budapest, 3: 113 pp.
8. MÓCZÁR L., SCHARZ M., 1968 - *A Nomada, Ammobates, Pasites és Parammobatodes nemek faunakatalógusa*, Rovartani Közlemények, Folia Entomologica Hungarica, 21 (23): 339-360. (in Hungarian)
9. POLASZEK, A., 2005 - *Fauna Europaea. Apidae family*. Internet: www.faunaeur.org/full results.php
10. SZILÁDY Z., 1914 - *Magyarországy rovargyüjtésem jegyzéke*, Rovartani Lapok, 21: 78-95. (in Hungarian)
11. ZILAHI – KISS E., 1915 - *Újab adatok Magyarország Hymenoptera – faunájához*, Rovartani Lapok, 22: 76-86. (in Hungarian).

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THE COMPARATIVE ANALYSIS OF THE ENTOMOFAUNA IN THE ALFALFA CROPS FROM SOME LOCALITIES IN THE NORTH - EAST OF MOLDAVIA COUNTY, DEPENDING ON THE CROPS' PHENOLOGICAL PHASE

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ABSTRACT

LISENCHI – MURARIU C., MOGLAN I., 2006 - The comparative analysis of the entomofauna in the alfalfa crops from some localities in the North - East of Moldavia County, depending on the crops' phenological phase. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 369-374.

In the paper we present the results of the made research referring to the entomofauna in alfalfa crops, depending on the phonological phase of the plant (in bloom and in the phenological phase of formation of the floral bud). We did not find out significant differences concerning the total number of samples of insects from the two types of alfalfa crops, but in what concerns the biodiversity, it is bigger in the alfalfa crops in bloom (50 taxa) in comparison with the alfalfa crops whose buds were in formation (39 taxa).

The alfalfa crops in bloom was preferred by *Thysanoptera, Heteroptera* and *Hymenoptera* and the alfalfa crops not in bloom was preferred by *Diptera* and *Collembola.*

In what concerns the useful entomofauna, the differences between the two types of alfalfa crops are significant moreover concerning the pollinator insects and the parasitoid entomofauna, mainly the *Chalcidoidea* and *Platygastroidea* suprafamilies.

Key words: entomofauna, alfalfa crop

Introduction

In Romania, alfalfa represents one of the most valuable fodder plants, tilled on wide areas. At the same time, in alfalfa crops the diversity of insects is abundant and on the other hand the number of individuals, at least in the case of some insect groups, can be extremely raised.

In our paper we present the entomofauna from two categories of alfalfa crops: alfalfa crops in bloom and in alfalfa crops which were in the phenological phase of formation of floral buds.

Material and Method

The gathering of the insects was achieved with the help of the entomological net from four alfalfa crops: in two alfalfa crops the plant was in bloom (in Cristeşti, District of Iaşi and in Cucorăni, District of Botoşani) and in the other two, the alfalfa crop was in the formation phase of the floral bud (in Blăgeşti, District of Iaşi an in Ipoteşti, District of Botoşani).

The drawing of the entomological material in all the alfalfa crops was fulfilled in June 2004, a sample of each alfalfa crop. The sampler consisted of 50 simple sweeping with the entomological net in each alfalfa crop.

Results and Discussion

From the examined alfalfa crops we gathered and analyzed totally 4838 samples of insects (2422 individuals in the alfalfa crops in bloom and 2416 in the alfalfa crops found in the phenological phase of formation of floral buds) which belonged to 11 orders (table 1).

The data made by us point out that in what concerns the number of individuals there aren't any significant differences between the two types of alfalfa crops, but in what concerns the biodiversity, it is bigger in the alfalfa crop in the bloom than in the alfalfa crop which is in the phenological phase of formation of the floral bud (50 taxa in the alfalfa crops in bloom and 39 taxa in those where the plants were in bud) (table 1).

The alfalfa crop in bloom was more preferred by the *Thysanoptera* (227 individuals in the alfalfa crop in bloom, in comparison with 145 individuals in the alfalfa crops whose buds were in formation), the *Heteroptera* (301 individuals in the alfalfa crop in bloom, in comparison with 76 individuals in the alfalfa crops whose buds were in formation) and *Hymenoptera* (461 individuals in the alfalfa crop in

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bloom, in comparison with 254 individuals in the alfalfa crops whose buds were in formation).

The raised number of thrips found in the alfalfa crops in bloom is explained by the fact that these insects feed themselves with the cellular content of the floral organs, especially of the germinal bottom hull which after the attack becomes dry, the stamina no longer open, and the flower remains sterile.

In the case of hymenopteras, as we expected, they were better represented numerically in the alfalfa crop in bloom than in the alfalfa crops whose buds were in formation. The differences concerning this order are given, moreover, by the pollination hymenopteras (*Apoidea*) (88 individuals in the alfalfa crop in bloom in comparison with two individuals in the alfalfa crop which was not in bloom) but also by the *Platygastroidea* superfamily (118 individuals in the alfalfa crop in bloom in comparison with 56 individuals in the alfalfa crop which was not in bloom) and the *Chalcidoidea* superfamily (233 individuals in the alfalfa crop in bloom in comparison with 127 individuals in the alfalfa crop which was not in bloom), which found here food (nectar) and hosts for laying eggs.

The alfalfa crops whose buds were in formation were preferred by collembolas and dipteras (table 1).

The *Homoptera* were dominated in both alfalfa crops and we did not find significant quantitive and qualitative differences between the two types of alfalfa crops (table 1).

Tab. 1 - The abundance and the dominance of the entomofauna found in the examined alfalfa crops

Nr. crt.	Taxa	Alfalfa crop in bloom				Alfalfa crop not in bloom			
		Cucorăni	Cristești	Total		Ipotești	Blăgești	Total	
		A	A	A	D	A	A	A	D
1	Subcls. *Apterygota*	0	53	53	2.19	1	136	137	5.67
2	**Order *Collembola***	**0**	**53**	**53**	**2.19**	**1**	**136**	**137**	**5.67**
3	Subord. *Symphypleona*	0	53	53	2.19	1	136	137	5.67
4	Fam. *Sminthuridae*	0	53	53	2.19	1	136	137	5.67
5	Subcls. *Pterygota*	743	1626	2369	97.81	1372	907	2279	94.33
6	**Order *Ephemeroptera***	**0**	**0**	**0**	**0.00**	**0**	**1**	**1**	**0.04**
7	**Order *Orthoptera***	**2**	**2**	**4**	**0.17**	**2**	**0**	**2**	**0.08**
8	Subord. *Ensifera*	1	0	1	0.04	0	0	0	0.00
9	Fam. *Tettigoniidae*	1	0	1	0.04	0	0	0	0.00
10	Subord. *Caelifera*	1	2	3	0.12	2	0	2	0.08
11	Fam. *Acrididae*	1	2	3	0.12	2	0	2	0.08
12	**Order *Thysanoptera***	**97**	**130**	**227**	**9.37**	**74**	**71**	**145**	**6.00**
13	Subord. *Terebrantia*	97	127	224	9.25	73	68	141	5.84
14	Fam. *Aeolothripidae*	33	41	74	3.06	31	36	67	2.77
15	Fam. *Thripidae*	64	86	150	6.19	42	32	74	3.06
16	Subord. *Tubulifera*	0	3	3	0.12	1	3	4	0.17
17	Fam. *Urotripidae*	0	3	3	0.12	1	3	4	0.17
18	**Order *Heteroptera***	**161**	**140**	**301**	**12.43**	**52**	**24**	**76**	**3.15**
19	Subord. *Gymnocerata*	161	140	301	12.43	52	24	76	3.15
20	Fam. *Pentatomidae*	0	0	0	0.00	0	1	1	0.04
21	Fam. *Tingididae*	0	4	4	0.17	0	0	0	0.00
22	Fam. *Miridae*	146	110	256	10.57	37	15	52	2.15
23	Fam. *Anthocoridae*	15	23	38	1.57	14	8	22	0.91
24	Fam. *Reduviidae*	0	3	3	0.12	1	0	1	0.04
25	**Order *Homoptera***	**139**	**828**	**967**	**39.93**	**627**	**380**	**1007**	**41.68**
26	Subord. *Cicadina*	47	21	68	2.81	95	12	107	4.43
27	Fam. *Cercopidae*	14	1	15	0.62	10	0	10	0.41
28	Fam. *Cicadidae*	33	20	53	2.19	85	12	97	4.01
29	Subord. *Psyllina*	2	0	2	0.08	1	0	1	0.04
30	Fam. *Psyllidae*	1	0	1	0.04	1	0	1	0.04
31	Fam. *Triozidae*	1	0	1	0.04	0	0	0	0.00
32	Subord. *Aphidina*	90	807	897	37.04	531	368	899	37.21
33	Fam. *Aphididae*	90	807	897	37.04	531	368	899	37.21
34	**Order *Hymenoptera***	**231**	**230**	**461**	**19.03**	**135**	**119**	**254**	**10.51**
35	Subord. *Clistogastra*	231	230	461	19.03	135	119	254	10.51

36	Suprafam. *Ichneumonoidea*	10	10	20	0.83	21	27	48	1.99
37	Fam. *Ichneumonidae*	0	1	1	0.04	4	2	6	0.25
38	Fam. *Braconidae*	7	2	9	0.37	6	3	9	0.37
39	Fam. *Aphidiidae*	3	7	10	0.41	11	22	33	1.37
40	Suprafam. *Cynipoidea*	3	0	3	0.12	3	0	3	0.12
41	Fam. *Cynipidae*	3	0	3	0.12	3	0	3	0.12
42	Suprafam. *latygastroidea*	54	64	118	4.87	23	33	56	2.32
43	Fam. *Scelionidae*	8	9	17	0.70	4	3	7	0.29
44	Fam. *Platygastridae*	46	55	101	4.17	19	30	49	2.03
45	Suprafam. *Ceraphronoidea*	4	1	5	0.21	2	4	6	0.25
46	Fam. *Ceraphronidae*	1	1	2	0.08	2	4	6	0.25
47	Fam. *Megaspilidae*	3	0	3	0.12	0	0	0	0.00
48	Suprafam. *Chalcidoidea*	104	119	223	9.21	73	54	127	5.26
49	Fam. *Eurytomidae*	21	2	23	0.95	0	0	0	0.00
50	Fam. *Pteromalidae*	22	44	66	2.73	17	12	29	1.20
51	Fam. *Encyrtidae*	3	0	3	0.12	8	1	9	0.37
52	Fam. *Aphelinidae*	0	0	0	0.00	6	2	8	0.33
53	Fam. *Eulophidae*	56	65	121	5.00	38	32	70	2.90
54	Fam. *Elasmidae*	1	0	1	0.04	0	0	0	0.00
55	Fam. *Trichogrammatidae*	1	0	1	0.04	0	0	0	0.00
56	Fam. *Mymaridae*	0	8	8	0.33	4	7	11	0.46
57	Suprafam. *Vespoidea*	0	4	4	0.17	11	1	12	0.50
58	Fam. *Formicidae*	0	4	4	0.17	11	1	12	0.50
59	Suprafam. *Apoidea*	56	32	88	3.63	2	0	2	0.08
60	**Order *Coleoptera***	**42**	**135**	**177**	**7.31**	**194**	**39**	**233**	**9.64**
61	Subord. *Polyphaga*	42	135	177	7.31	194	39	233	9.64
62	Fam. *Staphylinidae*	1	0	1	0.04	0	0	0	0.00
63	Fam. *Cantharidae*	1	0	1	0.04	0	0	0	0.00
64	Fam. *Melyridae*	1	2	3	0.12	0	0	0	0.00
65	Fam. *Elateridae*	1	0	1	0.04	1	0	1	0.04
66	Fam. *Nitidulidae*	1	1	2	0.08	0	1	1	0.04
67	Fam. *Lathridiidae*	3	11	14	0.58	3	3	6	0.25
68	Fam. *Coccinellidae*	12	21	33	1.36	16	7	23	0.95
69	Fam. *Scarabeidae*	0	1	1	0.04	0	0	0	0.00
70	Fam. *Chrysomelidae*	7	11	18	0.74	133	0	133	5.50
71	Fam. *Bruchidae*	0	8	8	0.33	0	0	0	0.00
72	Fam. *Curculionidae*	5	69	74	3.06	7	18	25	1.03
73	Fam. *Apionidae*	8	11	19	0.78	34	10	44	1.82
74	Fam. *Oedipodidae*	2	0	2	0.08	0	0	0	0.00
75	**Order *Neuroptera***	**2**	**2**	**4**	**0.17**	**3**	**0**	**3**	**0.12**
76	Fam. *Chrysopidae*	2	0	4	0.17	3	0	3	0.12
77	**Order *Lepidoptera***	**3**	**9**	**12**	**0.50**	**4**	**1**	**5**	**0.21**
78	Fam. *Geometridae*	2	8	10	0.41	0	1	1	0.04
79	*Microlepidoptere*	1	1	2	0.08	4	0	4	0.17
80	**Order *Diptera***	**66**	**150**	**216**	**8.92**	**281**	**272**	**553**	**22.89**
81	Subord. *Nematocera*	5	69	74	3.06	53	137	190	7.86
82	Subord. *Brachycera*	61	81	142	5.86	228	135	363	15.02
Total		**743**	**1679**	**2422**		**1373**	**1043**	**2416**	**743**

In what concerns the harmful entomofauna, the order *Thysanoptera*, *Heteroptera* and *Hymenoptera* were significantly better numerically represented in the alfalfa crops in bloom than in those whose buds were in formation, while in the case of the coleopteras the situation is reverse (table 2).

The obtained results point out the fact that in both types of examined alfalfa crops, the aphids were dominant, these ones finding in the alfalfa crops ecological factors propitious to the development and multiplication.

Tab. 2 - The abundance and the dominance of the harmful entomofauna found in the examined alfalfa crops

Nr. crt.	Taxa	Alfalfa crop in bloom				Alfalfa crop not in bloom			
		Cucorăni	Cristeşti	Total		Ipoteşti	Blăgeşti	Total	
		A	A	A	D	A	A	A	D
1	**Order *Orthoptera***	**2**	**2**	**4**	**0.26**	**2**	**0**	**2**	**0.15**
2	Fam. *Tettigoniidae*	1	0	1	0.06	0	0	0	0.00
3	Fam. *Acrididae*	1	2	3	0.19	2	0	2	0.15
4	**Order *Thysanoptera***	**64**	**89**	**153**	**9.94**	**43**	**35**	**78**	**5.76**
5	Fam. *Thripidae*	64	86	150	9.75	42	32	74	5.47
6	Fam. *Urotripidae*	0	3	3	0.19	1	3	4	0.30
7	**Order *Heteroptera***	**146**	**114**	**260**	**16.89**	**37**	**16**	**53**	**3.91**
8	Fam. *Pentatomidae*	0	0	0	0.00	0	1	1	0.07
9	Fam. *Tingididae*	0	4	4	0.26	0	0	0	0.00
10	Fam. *Miridae*	146	110	256	16.63	37	15	52	3.84
11	**Order *Homoptera***	**139**	**828**	**967**	**62.83**	**627**	**380**	**1007**	**74.37**
12	Fam. *Cercopidae*	14	1	15	0.97	10	0	10	0.74
13	Fam. *Cicadidae*	33	20	53	3.44	85	12	97	7.16
14	Fam. *Psyllidae*	1	0	1	0.06	1	0	1	0.07
15	Fam. *Triozidae*	1	0	1	0.06	0	0	0	0.00
16	Fam. *Aphididae*	90	807	897	58.28	531	368	899	66.40
17	**Order *Hymenoptera***	**21**	**1**	**22**	**1.43**	**0**	**0**	**0**	**0.00**
18	Fam. *Eurytomidae*	21	1	22	1.43	0	0	0	0.00
19	**Order *Coleoptera***	**20**	**101**	**121**	**7.86**	**180**	**29**	**209**	**15.44**
20	Fam. *Elateridae*	1	0	1	0.06	1	0	1	0.07
21	Fam. *Nitidulidae*	1	1	2	0.13	0	1	1	0.07
22	Fam. *Coccinellidae*	0	0	0	0.00	5	0	5	0.37
23	Fam. *Scarabeidae*	0	1	1	0.06	0	0	0	0.00
24	Fam. *Chrysomelidae*	7	11	18	1.17	133	0	133	9.82
25	Fam. *Bruchidae*	0	8	8	0.52	0	0	0	0.00
26	Fam. *Curculionidae*	4	69	73	4.74	7	18	25	1.85
27	Fam. *Apionidae*	7	11	18	1.17	34	10	44	3.25
28	**Order *Lepidoptera***	**3**	**9**	**12**	**0.78**	**4**	**1**	**5**	**0.37**
29	Fam. *Geometridae*	2	8	10	0.65	0	1	1	0.07
30	*Microlepidoptere*	1	1	2	0.13	4	0	4	0.30
Total		**395**	**1144**	**1539**		**893**	**461**	**1354**	

Concerning the useful entomofauna both in the alfalfa crops in bloom and in those not in bloom the most individuals belonged to the *Hymenoptera* order, but in the alfalfa crop in bloom, as we expected, the number of Hymenoptera was 1,8 times bigger than the number of Hymenoptera in the alfalfa crops not in bloom. Among these ones, the pollination Hymenoptera (*Apoidea*) were 44 times more in the alfalfa crops in bloom than in those not in bloom.

Tab. 3 - The abundance and the dominance of the useful entomofauna found in the examined alfalfa crops.

Nr. crt.	Taxa	Alfalfa crop in bloom				Alfalfa crop not in bloom			
		Cucorăni	Cristeşti	Total		Ipoteşti	Blăgeşti	Total	
		A	A	A	D	A	A	A	D
1	**Order *Heteroptera***	**15**	**26**	**41**	**7.59**	**15**	**8**	**23**	**7.72**
2	Fam. *Anthocoridae*	15	23	38	7.04	14	8	22	7.38
3	Fam. *Reduviidae*	0	3	3	0.56	1	0	1	0.34
4	**Order *Hymenoptera***	**231**	**230**	**461**	**85.37**	**135**	**119**	**254**	**85.23**
5	Suprafam. *Ichneumonoidea*	10	10	20	3.70	21	27	48	16.11
6	Fam. *Ichneumonidae*	0	1	1	0.19	4	2	6	2.01
7	Fam. *Braconidae*	7	2	9	1.67	6	3	9	3.02
8	Fam. *Aphidiidae*	3	7	10	1.85	11	22	33	11.07
9	Suprafam. Cynipoidea	3	0	3	0.56	3	0	3	1.01
10	Fam. *Cynipidae*	3	0	3	0.56	3	0	3	1.01
11	Suprafam. *Platygastroidea*	54	64	118	21.85	23	33	56	18.79
12	Fam. *Scelionidae*	8	9	17	3.15	4	3	7	2.35
13	Fam. *Platygastridae*	46	55	101	18.70	19	30	49	16.44
14	Suprafam. *Ceraphronoidea*	4	1	5	0.93	2	4	6	2.01
15	Fam. *Ceraphronidae*	1	1	2	0.37	2	4	6	2.01
16	Fam. *Megaspilidae*	3	0	3	0.56	0	0	0	0.00
17	Suprafam. *Chalcidoidea*	104	119	223	41.30	73	54	127	42.62
18	Fam. *Torymidae*	0	0	0	0.00	0	0	0	0.00
19	Fam. *Pteromalidae*	22	44	66	12.22	17	12	29	9.73
20	Fam. *Encyrtidae*	3	0	3	0.56	8	1	9	3.02
21	Fam. *Aphelinidae*	0	0	0	0.00	6	2	8	2.68
22	Fam. *Eulophidae*	56	65	121	22.41	38	32	70	23.49
23	Fam. *Elasmidae*	1	0	1	0.19	0	0	0	0.00
24	Fam. *Trichogrammatidae*	1	0	1	0.19	0	0	0	0.00
25	Fam. *Mymaridae*	0	8	8	1.48	4	7	11	3.69
26	Suprafam. *Vespoidea*	0	4	4	0.74	11	1	12	4.03
27	Fam. *Formicidae*	0	4	4	0.74	11	1	12	4.03
28	Suprafam. *Apoidea*	56	32	88	16.30	2	0	2	0.67
29	**Order *Coleoptera***	**13**	**21**	**34**	**6.30**	**11**	**7**	**18**	**6.04**
30	Fam. *Staphylinidae*	1	0	1	0.19	0	0	0	0.00
31	Fam. *Coccinellidae*	12	21	33	6.11	11	7	18	6.04
32	**Order *Neuroptera***	**2**	**2**	**4**	**0.74**	**3**	**0**	**3**	**1.01**
33	Fam. *Chrysopidae*	2	2	4	0.74	3	0	3	1.01
Total		**261**	**279**	**540**		**164**	**134**	**298**	

We also found that in the case of plundering heteropteras and of the useful ladybugs, their number is almost twice bigger in the alfalfa crops in bloom than in those not in bloom.

Conclusions

The biodiversity of entomofauna is bigger in the alfalfa crops in bloom than in those in the phenological phase of formation of the floral buds.

The alfalfa crops in bloom represent a valuable reservoir of useful entomofauna (pollinator insects, predaceous and parasitoids).

The harmful entomofauna in mainly represented by aphids, which are very well represented quantitatively both in the alfalfa crops in bloom and in those not in bloom.

Rezumat

În lucrare sunt prezentate rezultatele cercetărilor referitoare la entomofauna din lucernă, în funcție de fenofaza plantei (înflorită şi în faza de formare a mugurelui floral). Nu se constată diferențe semnificative în ce priveşte numărul total de exemplare de insecte din cele două tipuri de lucerniere, dar în ce priveşte biodiversitatea, aceasta este mai mare în lucernierele înflorite (50 taxoni) comparativ cu lucernierele neînflorite (39 taxoni).

Lucernierele înflorite au fost „preferate” de tisanoptere, heteroptere şi himenoptere, iar cele neînflorite de colembole şi diptere.

În ce priveşte entomofauna utilă diferențele între cele două tipuri de lucerniere sunt semnificative mai ales în ce priveşte insectele

polenizatoare dar şi în ce priveşte entomofauna parazitoidă, în principal cea din suprafamilia *Chalcidoidea* şi *Platygastroidea*.

Reference

1. BALOGH J., LOKSA J., 1956 - *Untersuchungen über die Zoozönose des Luzernefeldes.* Acta Zool., Budapest, 2: 7-114;
2. CHAUVIN R., 1960 - *La faune du champ cultivé et surtout du champ du luzerne.* Revue du travaux récents. Rev. de Zool. Agr., Bordeaux, 59, nr. 1-3:14-37; nr. 4-6: 69-79;
3. CHAUVIN R., LECOMTE J., 1958 - *Etudes d'Ecologie entomologique sur le champ de luzerne II. Evolution de la faune au cours de l'année et pendant le nychtémère.* Vie et Milieu, 9: 171-178
4. LĂCĂTUŞU M., TUDOR C., TEODORESCU I., NĂDEJI, M., 1981 - *Structura faunistică din culturi de lucernă.* St. Cerc. Biol., seria Biol. Anim., 33: 179-182
5. PERJU T., 1971 - *Dinamica entomofaunei culturilor de lucernă.* Lucr. Şt. Inst. Agr. „Dr. Petru Groza", seria Agricultură, XXVII: 421-436;
6. RADU GH. V., RADU, V. V., BECHET, I., MATIC, Z., BOŢOC M., DĂRĂBANŢU C., MICLUŢĂ, I., 1959 - *Complexul faunei de artropode din culturile de lucernă din jurul Clujului.* Studia Univ. Babeş - Bolyai Cluj, seria Biologie 2: 69-74;
7. ŞEARPE D., BANIŢĂ E., VOICU M., KIS., CIOLACU F., 1997 - *Abundenţa artropodelor dăunătoare şi utile din lucernierele semincere situate în sudul Olteniei.* An. I.C.C.P.T., LXIV: 267-278.

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ENTOMOFAUNA (ARTHROPODA, THE INSECT) FROM SOME ALFALFA CROPS IN THE NORTH – EAST OF MOLDAVIA

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ABSTRACT

LISENCHI – MURARIU C. , ANDRIESCU I., 2006 - Entomofauna (Arthropoda, the Insect) from some alfalfa crops in the north – east of Moldavia. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 375-382.

Entomofauna is studied, at the level of the superior taxa (Family), of three alfalfa crops destined to the fodder and which are not chemically treated in the North – East of Romania. The research was made in 2004, probing monthly samplers (June - September). We gathered 10500 samples of insects which belonged to 13 orders and 62 families. The dominant ones, in a decreasing order, were the *Homoptera*, *Hymenoptera* and *Diptera* orders.

We saw that these alfalfa crops represent a valuable reservoir of useful insects (predaceous, parasitoids and pollinators) and the disarranged ecological equilibrium (the big multiplication of phytophagous insects) is due to the repeated mowing and entirely during the season.

Key words: alfalfa crop, entomofauna, taxa

Introduction

In Romania there are many alfalfa crops on wide areas. Alfalfa is considered to be a valuable plant from the animals' fodder. At the same time, the alfalfa crops represent also an important reservoir for useful insects (pollinator insects, predaceous and parasitic insects) which find here food, on the alfalfa crop in bloom, as well as propitious microclimatic conditions, migrating then and colonizing other agro-ecosystems too.

From the research made on the entomofauna on alfalfa crops, we mention only some concerning entomofauna generally speaking, because there are other numerous papers dedicated to some groups of insects, harmful or useful, referring to this agro-ecosystem. Thus, we mention the authors's papers from Balogh and Loksa (1956) in Hungary; Chauvin (1958, 1960) in France and so on; and the Romanian authors' papers Radu and all (1959), Perju (1971), Şearpe and all (1997), and so on.

Material and Method

The study was made in 2004, in 3 alfalfa crops situated in the North - East of Romania, in three districts, at Draguşeni (Suceava), Ipoteşti (Botoşani), Cristeşti (Iaşi), these alfalfa crops being situated at a big distance one from another. The three alfalfa crops had neighbouring agricultural crops and the one from Draguşeni was situated nearby the river of Moldavia.

The gathering of the entomofauna was achieved on the data specified in the given tables, by using the entomological net and probing, on each sampler, a number of 50 simple sweepings on sunny days, between 12 and 14 o'clock.

Subsequently, the material was sorted and identified up to family, the taxon which was at the bottom of the debates.

As the alfalfa crops were destined to the fodder yield, these ones were mown and they were not chemically treated.

Results and Discussion

From the four samplers in the alfalfa crop from Drăguşeni district of Suceava, we gathered 3166 individuals of insects and we identified 52 taxa which belonged to 10 orders (*Collembola, Orthoptera, Thysanoptera, Heteroptera, Homoptera, Hymenoptera, Coleoptera, Neuroptera, Lepidoptera* and *Diptera*) (Table 1).

At the level of order, in the case of the *Homoptera*, the overwhelming majority of the individuals belonged to the aphids which held 95,1%. The raised abundance of aphids is explained, on one hand, by the raised prolification of these insects and on the other hand, by the phenomenon of migration of the neighbouring crops, due to the fact that the alfalfa crop was mown recurrently, the plants being young, preferred by aphids. The raised

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abundance of aphids was emphasized by other authors too (Şearpe and all, 1997).

In what concerns the *Thysanoptera* order, most of its individuals belonged to the *Thripidae* family, 54,5% from the total of the thysanopteras found in this alfalfa crop (Table 1). The high number of thrips found in this place can be explained by the fact that the two gatherings were achieved exactly when the alfalfa crop was in bloom, these insects feeding themselves with the cellular content of the floral organs especially the content of the germinal bottom hull which, after the attack it becomes dry, the stamina no longer open and the flower remains sterile.

Among the hymenopteras, the dominant suprafamily was the *Chalcidoidea* (51,8%), followed by the *Platygastroidea* (36,8%) and the *Ichneumonoidea* 6,7%.

Tab. 1 - The abundance and the dominance of the entomofauna found in the alfalfa crop from Drăguşeni, District of Suceava (D_1 – the dominance from the total of the gathered insects, D_2 - the dominance from the total of the insects at the level of order)

Nr. crt.	Taxa	Gathering data				Total		
		10.06.04	22.07.04	12.08.04	16.09.04			
		A	A	A	A	A	D_1	D_2
	Subcls. *Apterygota*	28	41	78	12	159	5.02	
I	***Collembola* Order**	**28**	**41**	**78**	**12**	**159**	**5.02**	
1	Fam. *Tomoceridae*	0	0	0	1	1	0.03	0.63
2	Fam. *Sminthuridae*	28	41	78	11	158	4.99	99.37
	Subcls. *Pterygota*	1001	575	829	602	3007	94.98	
II	***Orthoptera* Order**	**0**	**0**	**3**	**0**	**3**	**0.09**	
3	Fam. *Acrididae*	0	0	3	0	3	0.09	100
III	***Thysanoptera* Order**	**294**	**218**	**167**	**4**	**683**	**21.57**	
4	Fam. *Aeolothripidae*	103	148	30	2	283	8.94	41.43
5	Fam. *Thripidae*	167	69	135	1	372	11.75	54.47
6	Fam. *Urotripidae*	24	1	2	1	28	0.88	4.10
IV	***Heteroptera* Order**	**25**	**45**	**66**	**2**	**138**	**4.36**	
7	Fam. *Pentatomidae*	3	15	0	0	18	0.57	13.04
8	Fam. *Tingididae*	0	5	0	0	5	0.16	3.62
9	Fam. *Miridae*	14	14	62	2	92	2.91	66.67
10	Fam. *Anthocoridae*	6	9	4	0	19	0.60	13.77
11	Fam. *Reduviidae*	2	2	0	0	4	0.13	2.90
V	***Homoptera* Order**	**289**	**76**	**147**	**476**	**988**	**31.21**	
12	Fam. *Cercopidae*	2	1	2	0	5	0.16	0.51
13	Fam. *Cicadidae*	15	5	6	6	32	1.01	3.24
14	Fam. *Membracidae*	0	0	8	1	9	0.28	0.91
15	Fam. *Psyllidae*	2	0	0	0	2	0.06	0.20
16	Fam. *Aphididae*	270	70	131	469	940	29.69	95.14
VI	***Hymenoptera* Order**	**156**	**166**	**309**	**37**	**668**	**21.10**	
17	Fam. *Tenthredinidae*	1	0	0	0	1	0.03	0.15
	Suprafam. *Ichneumonoidea*	12	6	22	5	45	1.42	6.74
18	Fam. *Ichneumonidae*	2	0	1	1	4	0.13	0.60
19	Fam. *Braconidae*	9	3	21	2	35	1.11	5.24
20	Fam. *Aphidiidae*	1	3	0	2	6	0.19	0.90
	Suprafam. *Cynipoidea*	2	2	0	2	6	0.19	0.90
21	Fam. *Cynipidae*	2	2	0	2	6	0.19	0.90
	Suprafam. *Proctotrupoidea*	0	1	0	0	1	0.03	0.15
22	Fam. *Diapriidae*	0	1	0	0	1	0.03	0.15
	Suprafam. *Platygastroidea*	35	47	160	4	246	7.77	36.83
23	Fam. *Scelionidae*	2	1	2	0	5	0.16	0.75
24	Fam. *Platygastridae*	33	46	158	4	241	7.61	36.08
	Suprafam. *Ceraphronoidea*	4	2	3	0	9	0.28	1.35
25	Fam. *Ceraphronidae*	3	0	3	0	6	0.19	0.90
26	Fam. *Megaspilidae*	1	2	0	0	3	0.09	0.45
	Suprafam. *Chalcidoidea*	97	105	119	25	346	10.93	51.80

27	Fam. *Torymidae*	2	1	2	0	5	0.16	0.75
28	Fam. *Eurytomidae*	6	1	3	1	11	0.35	1.65
29	Fam. *Pteromalidae*	37	36	47	12	132	4.17	19.76
30	Fam. *Encyrtidae*	2	4	6	1	13	0.41	1.95
31	Fam. *Aphelinidae*	1	1	1	0	3	0.09	0.45
32	Fam. *Eulophidae*	45	61	59	11	176	5.56	26.35
33	Fam. *Mymaridae*	4	1	1	0	6	0.19	0.90
	Suprafam. *Vespoidea*	4	1	3	1	9	0.28	1.35
34	Fam. *Formicidae*	4	1	3	1	9	0.28	1.35
35	Suprafam. *Apoidea*	1	2	2	0	5	0.16	0.75
VII	***Coleoptera* Order**	**99**	**23**	**24**	**0**	**146**	**4.61**	
36	Fam. *Cantharidae*	9	0	0	0	9	0.28	6.16
37	Fam. *Melyridae*	1	0	0	0	1	0.03	0.68
38	Fam. *Nitidulidae*	4	0	1	0	5	0.16	3.42
39	Fam. *Phalacridae*	0	1	0	0	1	0.03	0.68
40	Fam. *Lathridiidae*	2	3	12	0	17	0.54	11.64
41	Fam. *Coccinellidae*	3	2	4	0	9	0.28	6.16
42	Fam. *Cerambicidae*	1	0	0	0	1	0.03	0.68
43	Fam. *Chrysomelidae*	5	12	1	0	18	0.57	12.33
44	Fam. *Bruchidae*	1	0	0	0	1	0.03	0.68
45	Fam. *Curculionidae*	37	4	4	0	45	1.42	30.82
46	Fam. *Apionidae*	33	1	2	0	36	1.14	24.66
47	Fam. *Oedipodidae*	3	0	0	0	3	0.09	2.05
VIII	***Neuroptera* Order**	**0**	**1**	**2**	**0**	**3**	**0.09**	
48	Fam. *Chrysopidae*	0	1	2	0	3	0.09	100
IX	***Lepidoptera* Order**	**4**	**4**	**14**	**0**	**22**	**0.69**	
49	Fam. *Geometridae*	3	1	13	0	17	0.54	77.27
50	*Microlepidoptere*	1	3	1	0	5	0.16	22.73
X	**Diptera Order**	**134**	**42**	**97**	**83**	**356**	**11.24**	
51	Subord. *Nematocera*	64	13	19	26	122	3.85	34.27
52	Subord. *Brachycera*	70	29	78	57	234	7.39	65.73
	Total	**1029**	**616**	**907**	**614**	**3166**		

From the examined alfalfa crop in Ipoteşti, district of Botoşani, we gathered and analysed 3488 samples of insects which belonged to 48 families from 11 orders of insects (Table 2).

At the level of order, the most of the individuals belonged to the *Homoptera* order, which represented 39,9% from the total of gathered insects, followed by the *Diptera* order (21,3%) and *Hymenoptera* (17,2%) (Table 2).

In what concerns the Homoptera order, the clearly dominants ones were the aphids, 82,9% from the total of the homopteras belonging to the green plants lice.

Tab. 2 - The abundance and the dominance of the entomofauna found in the alfalfa crop from Ipoteşti, District of Botoşani (D_1 – the dominance from the total of the gathered insects, D_2 - the dominance from the total of the insects at the level of order)

Nr. crt.	Taxa	Gathering data				Total		
		22.06.04	**30.07.04**	**29.08.04**	**28.09.04**			
		A	**A**	**A**	**A**	**A**	**D1**	**D2**
	Subcls. *Apterygota*	1	11	12	40	64	1.83	
I	***Collembola* Order**	**1**	**11**	**12**	**40**	**64**	**1.83**	
1	Fam. *Tomoceridae*	0	2	0	22	24	0.69	37.5
2	Fam. *Sminthuridae*	1	9	12	18	40	1.15	62.5
	Subcls. *Pterygota*	1372	393	614	1045	3424	98.17	
II	***Orthoptera* Order**	**2**	**0**	**0**	**0**	**2**	**0.06**	
3	Fam. *Acrididae*	2	0	0	0	2	0.06	100
III	***Dermaptera* Order**	**0**	**0**	**0**	**1**	**1**	**0.03**	
4	Fam. *Forficulidae*	0	0	0	1	1	0.03	100

IV	***Thysanoptera* Order**	**74**	**38**	**35**	**36**	**183**	**5.25**	
5	Fam. *Aeolothripidae*	31	28	11	1	71	2.04	38.80
6	Fam. *Thripidae*	42	9	24	35	110	3.15	60.11
7	Fam. *Urotripidae*	1	1	0	0	2	0.06	1.09
V	***Heteroptera* Order**	**52**	**29**	**85**	**39**	**205**	**5.88**	
8	Fam. *Pyrrhochoridae*	0	0	0	1	1	0.03	0.49
9	Fam. *Miridae*	37	25	62	23	147	4.21	71.71
10	Fam. *Anthocoridae*	14	0	19	6	39	1.12	19.02
11	Fam. *Reduviidae*	1	4	4	9	18	0.52	8.78
VI	***Homoptera* Order**	**627**	**36**	**67**	**661**	**1391**	**39.88**	
12	Fam. *Cercopidae*	10	2	1	0	13	0.37	0.93
13	Fam. *Cicadidae*	85	2	8	127	222	6.36	15.96
14	Fam. *Membracidae*	0	0	1	0	1	0.03	0.07
15	Fam. *Psyllidae*	1	0	1	0	2	0.06	0.14
16	Fam. *Triozidae*	0	0	0	0	0	0.00	0.00
17	Fam. *Aphididae*	531	32	56	534	1153	33.06	82.89
VII	***Hymenoptera* Order**	**135**	**119**	**247**	**99**	**600**	**17.20**	
	Suprafam. *Ichneumonoidea*	21	14	20	28	83	2.38	13.83
18	Fam. *Ichneumonidae*	4	0	1	1	6	0.17	1.00
19	Fam. *Braconidae*	6	13	16	17	52	1.49	8.67
20	Fam. *Aphidiidae*	11	1	3	10	25	0.72	4.17
	Suprafam. *Cynipoidea*	3	0	0	1	4	0.11	0.67
21	Fam. *Cynipidae*	3	0	0	1	4	0.11	0.67
	Suprafam. *Proctotrupoidea*	0	1	3	0	4	0.11	0.67
22	Fam. *Proctotrupidae*	0	1	0	0	1	0.03	0.17
23	Fam. *Diapriidae*	0	0	3	0	3	0.09	0.50
	Suprafam. *Platygasteroidea*	23	7	57	8	95	2.72	15.83
24	Fam. *Scelionidae*	4	1	0	0	5	0.14	0.83
25	Fam. *Platygasteridae*	19	6	57	8	90	2.58	15.00
	Suprafam. *Ceraphronoidea*	2	1	0	0	3	0.09	0.50
26	Fam. *Ceraphronidae*	2	1	0	0	3	0.09	0.50
	Suprafam. *Chalcidoidea*	73	78	162	51	364	10.44	60.67
27	Fam. *Torymidae*	0	0	2	1	3	0.09	0.50
28	Fam. *Eurytomidae*	0	0	7	0	7	0.20	1.17
29	Fam. *Pteromalidae*	17	12	60	18	107	3.07	17.83
30	Fam. *Eupelmidae*	0	1	0	0	1	0.03	0.17
31	Fam. *Encyrtidae*	8	3	3	9	23	0.66	3.83
32	Fam. *Aphelinidae*	6	0	0	0	6	0.17	1.00
33	Fam. *Eulophidae*	38	59	85	22	204	5.85	34.00
34	Fam. *Trichogrammatidae*	0	1	0	0	1	0.03	0.17
35	Fam. *Mymaridae*	4	2	5	1	12	0.34	2.00
	Suprafam. *Chrysidoidea*	0	0	1	0	1	0.03	0.17
36	Fam. *Bethylidae*	0	0	1	0	1	0.03	0.17
	Suprafam. *Vespoidea*	11	17	4	10	42	1.20	7.00
37	Fam. *Formicidae*	11	17	3	10	41	1.18	6.83
38	Fam. *Vespidae*	0	0	1	0	1	0.03	0.17
39	Suprafam. *Apoidea*	2	1	0	1	4	0.11	0.67
VIII	***Coleoptera* Order**	**194**	**31**	**9**	**44**	**278**	**7.97**	
40	Fam. *Elateridae*	1	0	0	0	1	0.03	0.36
41	Fam. *Lathridiidae*	3	2	0	2	7	0.20	2.52
42	Fam. *Coccinellidae*	16	9	5	6	36	1.03	12.95
43	Fam. *Anthicidae*	0	1	0	0	1	0.03	0.36
44	Fam. *Chrysomelidae*	133	2	1	2	138	3.96	49.64
45	Fam. *Bruchidae*	0	0	0	1	1	0.03	0.36

46	Fam. *Curculionidae*	7	17	3	29	56	1.61	20.14
47	Fam. *Apionidae*	34	0	0	4	38	1.09	13.67
IX	***Neuroptera* Order**	**3**	**2**	**0**	**0**	**5**	**0.14**	
48	Fam. *Chrysopidae*	3	2	0	0	5	0.14	100
X	***Lepidoptera* Order**	**4**	**4**	**7**	**1**	**16**	**0.46**	
49	Fam. *Geometridae*	0	2	6	0	8	0.23	50
50	*Microlepidoptere*	4	2	1	1	8	0.23	50
XI	***Diptera* Order**	**281**	**134**	**164**	**164**	**743**	**21.30**	
51	Subord. *Nematocera*	53	42	69	42	206	5.91	27.73
52	Subord. *Brachycera*	228	92	95	122	537	15.40	72.27
	Total	**1373**	**404**	**626**	**1085**	**3488**		

In the case of the alfalfa crop in Cristeşti, District of Iaşi, during the four samplers we gathered and examined 3846 samples of insects which belonged to 47 families from 12 orders (Table 3).

The same as the first two examined alfalfa crops, the dominant ones were still the homopteras which had 35,4% from the total of insects, followed by the hymenopteras (16,5%) and the collembolas (13,2%) (Table 3).

The raised number of collembolas found in this place is explained by the fact that the alfalfa crop was nearby the Moldova river (high humidity), but also by the fact that the density of the plants here was very big, this way appearing a humidity propitious to the biological necessities of these insects.

Tab. 3 - The abundance and the dominance of the entomofauna found in the alfalfa crop from Cristeşti, District of Iaşi (D_1 – the dominance from the total of the gathered insects, D_2 - the dominance from the total of the insects at the level of order)

Nr. crt.	Taxa	Gathering data				Total		
		10.06.04	22.07.04	12.08.04	16.09.04			
		A	A	A	A	A	D1	D2
	Subcls. *Apterygota*	53	297	151	5	506	13.16	
I	***Collembola* Order**	**53**	**297**	**151**	**5**	**506**	**13.16**	
1	Fam. *Tomoceridae*	0	0	3	0	3	0.08	0.59
2	Fam. *Sminthuridae*	53	297	148	5	503	13.08	99.41
	Subcls. *Pterygota*	1626	351	950	413	3340	86.84	
II	***Ephemeroptera* Order**	**0**	**0**	**2**	**0**	**2**	**0.05**	
III	***Orthoptera* Order**	**2**	**3**	**0**	**0**	**5**	**0.13**	
3	Fam. *Acrididae*	2	3	0	0	5	0.13	100
IV	***Thysanoptera* Order**	**130**	**101**	**201**	**1**	**433**	**11.26**	
4	Fam. *Aeolothripidae*	41	74	134	0	249	6.47	57.51
5	Fam. *Thripidae*	86	25	67	1	179	4.65	41.34
6	Fam. *Urotripidae*	3	2	0	0	5	0.13	1.15
V	***Heteroptera* Order**	**140**	**8**	**35**	**14**	**197**	**5.12**	
7	Fam. *Scutelleridae*	0	1	0	0	1	0.03	0.51
8	Fam. *Tingididae*	4	0	1	0	5	0.13	2.54
9	Fam. *Miridae*	110	5	26	14	155	4.03	78.68
10	Fam. *Anthocoridae*	23	2	8	0	33	0.86	16.75
11	Fam. *Reduviidae*	3	0	0	0	3	0.08	1.52
VI	***Homoptera* Order**	**828**	**41**	**212**	**282**	**1363**	**35.44**	
12	Fam. *Cercopidae*	1	0	0	0	1	0.03	0.07
13	Fam. *Cicadidae*	20	5	11	14	50	1.30	3.67
14	Fam. *Membracidae*	0	0	3	0	3	0.08	0.22
15	Fam. *Triozidae*	0	0	0	1	1	0.03	0.07
16	Fam. *Aphididae*	807	36	198	267	1308	34.01	95.96
VII	***Hymenoptera* Order**	**230**	**76**	**274**	**53**	**633**	**16.46**	
	Suprafam. *Ichneumonoidea*	10	6	12	2	30	0.78	4.74
17	Fam. *Ichneumonidae*	1	1	1	0	3	0.08	0.47

18	Fam. *Braconidae*	2	1	10	2	15	0.39	2.37
19	Fam. *Aphidiidae*	7	4	1	0	12	0.31	1.90
	Suprafam. *Cynipoidea*	0	0	5	1	6	0.16	0.95
20	Fam. *Cynipidae*	0	0	5	1	6	0.16	0.95
	Suprafam. *Proctrupoidea*	0	0	1	0	1	0.03	0.16
21	Fam. *Diapriidae*	0	0	1	0	1	0.03	0.16
	Suprafam. *Platygastroidea*	64	7	138	2	211	5.49	33.33
22	Fam. *Scelionidae*	9	2	6	1	18	0.47	2.84
23	Fam. *Platygastridae*	55	5	132	1	193	5.02	30.49
	Suprafam. *Ceraphronoidea*	1	0	4	0	5	0.13	0.79
24	Fam. *Ceraphronidae*	1	0	3	0	4	0.10	0.63
25	Fam. *Megaspilidae*	0	0	1	0	1	0.03	0.16
	Suprafam. *Chalcidoidea*	119	60	95	38	312	8.11	49.29
26	Fam. *Torymidae*	0	0	1	0	1	0.03	0.16
27	Fam. *Eurytomidae*	2	0	2	0	4	0.10	0.63
28	Fam. *Pteromalidae*	44	12	44	6	106	2.76	16.75
29	Fam. *Perilampidae*	0	0	1	0	1	0.03	0.16
30	Fam. *Encyrtidae*	0	8	9	1	18	0.47	2.84
31	Fam. *Aphelinidae*	0	5	9	1	15	0.39	2.37
32	Fam. *Eulophidae*	65	35	24	28	152	3.95	24.01
33	Fam. *Trichogrammatidae*	0	0	2	2	4	0.10	0.63
34	Fam. *Mymaridae*	8	0	3	0	11	0.29	1.74
	Suprafam. *Chrysidoidea*	0	0	1	0	1	0.03	0.16
35	Fam. *Bethylidae*	0	0	1	0	1	0.03	0.16
	Suprafam. *Vespoidea*	4	0	17	10	31	0.81	4.90
36	Fam. *Formicidae*	4	0	17	10	31	0.81	4.90
37	Suprafam. *Apoidea*	32	3	1	0	36	0.94	5.69
VIII	***Coleoptera* Order**	**135**	**19**	**24**	**3**	**181**	**4.71**	
38	Fam. *Melyridae*	2	0	0	0	2	0.05	1.10
39	Fam. *Nitidulidae*	1	0	0	0	1	0.03	0.55
40	Fam. *Lathridiidae*	11	0	0	0	11	0.29	6.08
41	Fam. *Coccinellidae*	21	5	1	0	27	0.70	14.92
42	Fam. *Scarabeidae*	1	0	0	0	1	0.03	0.55
43	Fam. *Chrysomelidae*	11	5	7	1	24	0.62	13.26
44	Fam. *Bruchidae*	8	0	0	0	8	0.21	4.42
45	Fam. *Curculionidae*	69	9	15	2	95	2.47	52.49
46	Fam. *Apionidae*	11	0	1	0	12	0.31	6.63
IX	***Strepsiptera* Order**	**0**	**1**	**0**	**0**	**1**	**0.03**	
X	***Neuroptera* Order**	**2**	**0**	**3**	**0**	**5**	**0.13**	
47	Fam. *Chrysopidae*	2	0	3	0	5	0.13	100
XI	***Lepidoptera* Order**	**9**	**2**	**12**	**2**	**25**	**0.65**	
48	Fam. *Geometridae*	8	2	12	2	24	0.62	96
49	*Microlepidoptere*	1	0	0	0	1	0.03	4
XII	***Diptera* Order**	**150**	**100**	**187**	**58**	**495**	**12.87**	
50	Subord. *Nematocera*	69	23	68	14	174	4.52	35.15
51	Subord. *Brachycera*	81	77	119	44	321	8.35	64.85
	Total	**1679**	**648**	**1101**	**418**	**3846**		

In the three alfalfa crops which were studied, we gathered and analysed, totally, 10500 samples of insects which belonged to 13 orders (Table 4).

Analysing comparatively the entomofauna in the three examined alfalfa crops, the obtained results do not point out significant differences in what concerns the total number of samples of insects found in these alfalfa crops (3166 in the alfalfa crop from Drăguşeni, 3488 from Ipoteşti and 3846 from Cristeşti).

At the level of insect order we found significant differences in the case of the collembolas (506 samples in alfalfa crops from Cristeşti in comparison with 159 from Drăguşeni and only 64 at

Ipoteşti), of the thysanopteras (683 samples at Drăguşeni, 433 at Cristeşti and only 183 at Ipoteşti) and in the case of the dipteras (743 samples at Ipoteşti in comparison with 495 samples at Cristeşti and 356 samples at Drăguşeni). At the rest of the insect orders the values of the dominance are somehow near (Table 4).

All over the analysed entomofauna in the three alfalfa crops for fodder, the data we obtained point out that the *Homoptera* through the aphids are clearly the dominant ones (35,6%from the total of the gathered insects), followed by *Hymenoptera* (18.1%) and *Diptera* (15,2%) (Table 4).

So, the alfalfa crops, at least for this area, represent a rich reservoir for aphids but, at the same time, of parasitoid hymenopteras.

The least individuals belonged to the *Orthoptera* (0,1%), *Lepidoptera* (0,6%) and S*trepsiptera* (0,01%) (Table 4).

Tab. 4 - The abundance and the dominance of the entomofauna gathered in the examined alfalfa crops (at the level of order)

Nr. crt.	Taxa	Gathering data						Total	
		Ipoteşti		Drăguşeni		Cristeşti			
		A	D	A	D	A	D	A	D
I	*Subcls. Apterygota*	64	1.83	159	5.02	506	13.16	729	6.94
1	Collembola Order	64	1.83	159	5.02	506	13.16	729	6.94
II	*Subcls. Pterygota*	3424	98.17	3007	94.98	3340	86.84	9771	93.06
2	Ephemeroptera Order	0	0.00	0	0.00	2	0.05	2	0.02
3	Orthoptera Order	2	0.06	3	0.09	5	0.13	10	0.10
4	Dermaptera Order	1	0.03	0	0.00	0	0.00	1	0.01
5	Thysanoptera Order	183	5.25	683	21.57	433	11.26	1299	12.37
6	Heteroptera Order	205	5.88	138	4.36	197	5.12	540	5.14
7	Homoptera Order	1391	39.88	988	31.21	1363	35.44	3742	35.64
8	Hymenoptera Order	600	17.20	668	21.10	633	16.46	1901	18.10
9	Coleoptera Order	278	7.97	146	4.61	181	4.71	605	5.76
10	Strepsiptera. Order	0	0.00	0	0.00	1	0.03	1	0.01
11	Neuroptera Order	5	0.14	3	0.09	5	0.13	13	0.12
12	Lepidoptera Order	16	0.46	22	0.69	25	0.65	63	0.60
13	Diptera Order	743	21.30	356	11.24	495	12.87	1594	15.18
	Total	**3488**		**3166**		**3846**		**10500**	

Comparing the data we obtained with those from the speciality literature, we found out some differences. Thus Radu and all (1959) for the alfalfa crops nearly Cluj, mention that the coleopteras are the dominant ones, followed closely by the hemipteras, the least individuals belonging to the hymenopteras.

A decade later, Perju (1971) in the alfalfa crops studied nearly Cluj, mentions that the *Coleoptera* order are the dominant ones (40,9% from the total of the insect individuals), followed by the *Homoptera* order (17,7%), the *Diptera* (14%), the *Heteroptera* (13,0%), the *Hymenoptera* (7,8%), the *Thysanoptera* (2,8%), the *Orthoptera* (0,5%) and the *Lepidoptera* (0,3%).

Conclusions

In the studied alfalfa crops the diversity of the entomofauna is extremely rich, we identified 52 superior taxa, and the abundance of some taxa has a great value, due to the fact that the crops were not treated chemically.

At the level of order, in all the examined alfalfa crops, the dominant ones were the aphids but also the *Hymenoptera*, the *Diptera* and the *Thysanoptera*.

The alfalfa crops, at least for this area, represent a valuable reservoir of useful entomofauna, mainly parasitoid.

The fact that there cannot be remarked evidently a correlation of the dynamic of the main phytophagous species (eg. the aphids) and their natural enemies (*Hymenoptera*, *Coleoptera* and *Neuroptera*) is due to the repeated mowing of the alfalfa, for fodder.

Rezumat

Se studiază entomofauna la nivelul taxonilor superiori (Familie) a trei lucerniere destinate furajului şi netratate chimic din nord – estul României. Cercetările s-au făcut în anul 2004, practicându-se eşantionări lunare (iunie - septembrie). S-au colectat 10500 de exemplare de insecte care au aparținut la 13 ordine şi 53 de familii. Dominante în ordine descrescătoare au fost ordinele *Homoptera* (*Aphidae*), *Hymenoptera*, *Diptera* şi

Thysanoptera. Se constată că aceste lucerniere constituie un valoros rezervor de insecte utile (prădători, parazitoizi şi polenizatori), iar echilibrul ecologic dereglat (înmulțirea mare a insectelor fitofage) se datorează cosirii repetate şi în totalitate pe parcursul sezonului a acestor culturi.

Reference

8. BALOGH J., LOKSA J., 1956 - *Untersuchungen über die Zoozönose des Luzernefeldes.* Acta Zool., Budapest, 2: 7-114;
9. CHAUVIN R., 1960 - *La faune du champ cultivé et surtout du champ du luzerne.* Revue du travaux récents. Rev. de Zool. Agr., Bordeaux, 59, nr. 1-3:14-37; nr. 4-6: 69-79;
10. CHAUVIN R., LECOMTE, J., 1958 - *Etudes d'Ecologie entomologique sur le champ de luzerne II. Evolution de la faune au cours de l'année et pendant le nychtémère.* Vie et Milieu, 9: 171-178
11. LĂCĂTUŞU M., TUDOR C., TEODORESCU I., NĂDEJI M., 1981 - *Structura faunistică din culturi de lucernă.* St. Cerc. Biol., seria Biol. Anim., 33: 179-182
12. PERJU T., 1971 - *Dinamica entomofaunei culturilor de lucernă.* Lucr. Şt. Inst. Agr. „Dr. Petru Groza", seria Agricultură, XXVII: 421-436;
13. RADU GH. V., RADU V. V., BECHET, I., MATIC Z., BOȚOC M., DĂRĂBANȚU C., MICLUȚĂ I., 1959 - *Complexul faunei de artropode din culturile de lucernă din jurul Clujului.* Studia Univ. Babeş - Bolyai Cluj, seria Biologie 2: 69-74;
14. ŞEARPE D., BANIȚĂ E., VOICU M., KIS., CIOLACU F., 1997 - *Abundența artropodelor dăunătoare şi utile din lucernierele semincere situate în sudul Olteniei.* An. I.C.C.P.T., LXIV: 267-278.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 383 – 388

BIOMETRIC STUDY OF *LIPARIS LIPARIS* POPULATION (LINNAEUS, 1766) (PISCES: LIPARIDIDAE) IN SPITSBERGEN ISLAND, SVALBARD ARCHIPELAGO, NORWAY

[The results of the 1991 „Spitsbergen II" Expedition]

NICOLAE CRĂCIUN*

ABSTRACT

CRĂCIUN N., 2006 - Biometric study of *Liparis liparis* population (Linnaeus, 1766) (Pisces: Liparididae) in Spitsbergen Island, Svalbard Archipelago, Norway. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 383-388.

We analyzed 30 individuals of *Liparis liparis* (Pisces: Liparididae) collected in Spitsbergen Island, Svalbard Archipelago, Norway, within the Spitsbergen II expedition, when we recorded 15 biometrical characteristics and we established the variability limits for the analyzed population.

We also analyzed 5 meristic characteristics and their variability.

Key words: Svalbard Archipelago, Spitsbergen Island, *Liparis liparis*, biometry.

Introduction

Systematically speaking, *Liparis liparis* (Linnaeus, 1766) belong to the Order Scorpaeniformes, Suborder Cottoidei, Family Liparidae, which includes over 195 species (Moyle & Cech, 2004).

The fish in this family are characterized by an elongated body, with no scales, with a gelatinous aspect; the dorsal fin (28-82 soft rays) and the anal flip (24-76 soft rays) are long, more or less concrescute with the caudal fin; the abdominal fins (sucker) are absent among some species of *Paraliparis* and *Nectoliparis*; the nostrils are single or in pairs (especially for *Liparis* genre); they have 38-86 vertebra. The maximum length is of approximately 50 cm.

Liparis liparis is characterized by: the anal fin, which has over 25 rays, but no more than 37, and the sucker's diameter, which is much larger than the eye's diameter. The Dorsal and the Anal prolonged themselves with over 1/4th to ½ of the caudal fin. There are two nostrils on each side of the mouth, (Muus & Nielsen, 1999).

Liparis liparis lives in the subtidal zone at less than 300 m deep, (Stein & Able, 1986). It feeds on shell fish, especially shrimps, crabs and amphipods, and occasionally with other fish or polychaetes, (Stein & Able, 1986). They lay their roe during the winter, from December to March, and they have a diameter of 1.4-1.7 mm, and the larva is pelagic (Muus & Nielsen, 1999).

The area includes the north-west of the Atlantic Ocean, the south of Norway, from the south of Norway to the north, in the Barents Sea, including Novaya Zemlya, Spitsbergen, Bear Island and Iceland.

The analyzed subjects belong to the *Liparis liparis liparis* subspecies, whose areal lies from the south of Norway to the north, at the Barents Sea, including Novaya Zemlya and Spitsbergen.

The maximum dimension is 15.0 cm (Muus & Dahlström, 1978).

Material and methods

Between the 24th of July and the 22nd of august 1991, we have been analyzing from a biometrical point of view a population of *Liparis liparis* from Spitsbergen Island, (Svalbard Archipelago, Norway), taking into consideration both the morphometric and the meristic characteristics.

The analyzed biometrical characteristics were: the total length (TL), Standard Length (SL), minimum height of the body (h), the length of the head (lc), the height of the head (hc), the diameter of the eye (Oh), the preorbital distance (prO), the postorbital distance (poO), the interorbital distance (io), the length of the dorsal base (lD), the length of

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the anal base (lA), the predorsal distance (pD), the preventral distance (pV) and the preanal distance (pA).

Among the meristic characteristics, we analyzed the number of the rays from the dorsal fin, the anal fin, the pectoral fin, the ventral fin and the caudal fin.

Fig. 1 - *Liparis liparis* (Linnaeus, 1766), dorsal view (left) and ventral view (right), (original), collected in the Spitsbergen Island, Svalbard Archipelago, Norway.

Fig. 2 - *Liparis liparis* (Linnaeus, 1766), side view (original), collected Spitsbergen Island, Svalbard Archipelago, Norway.

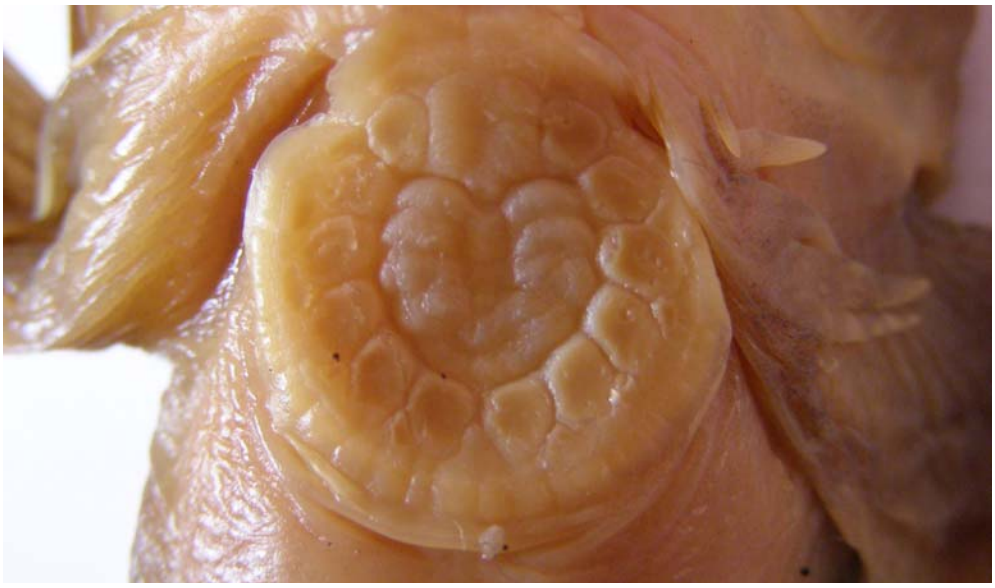

Fig. 3 – Sucker of *Liparis liparis* (Linnaeus, 1766), detail, ventral view (original), collected Spitsbergen Island, Svalbard Archipelago, Norway.

Results and discussions
Analysis of the metric characteristics:

The value of the main metrical characters which have been analyzed can be found in Table 1 and the minimum and maximum values and also the average value can be found in Table 2.

The total length (TL), measured in straight line from the tip of the mouth to the tip of the caudal fin, varies between 5.2 cm (minimum) and 11 cm (maximum) , with an average of 8.04 cm.

The standard length (SL), or the length of the body, measured from the tip of the mouth to the end of the body's scale layer, varies between 4.5 cm (minimum) and 9.8 cm (maximum), with an average of 7.06 cm.

The minimum height of the body (h), measured at the caudal peduncle level, ranged between 0.3 cm (minimum) and 0.62 cm (maximum), with an average of 0.42 cm.

The length of the head (lc) measured from the tip of the mouth to the posterior side of the opercular apparatus, varied between 1.4 cm (minimum) and 7.1 cm (maximum), with an average of 2.25 cm.

The height of the head (hc), the maximum height varied between 1.1 cm (minimum) and 2.8 cm (maximum), with an average of 1.94 cm.

The diameter of the eye (Oh), measured in longitude, varied between 0.3 cm (minimum) and 0.5 cm (maximum), with an average of 0.41 cm.

The preorbital distance (prO) measured from the tip of the mouth to the foreside of the eye, varied between 0.53 cm (minimum) and 1.16 cm (maximum) with an average of 0.82 cm.

The postorbital distance (poO) measured from the vertical line of the posterior side of the eye to the side of the gill membrane varied between 0.7 cm (minimum) and 1.52 cm (maximum) with an average of 1.09 cm.

The interorbital distance (io), the minimal distance between the orbits, measured in a straight line on the dorsal side of the head, varied between 0.5 cm (minimum) and 1.1 cm (maximum), with an average of 0.76 cm.

The length of the dorsal base (lD) measured in a straight line between the foreside of the first ray and posterior side of the last ray of the dorsal fin, varied between 3.32 cm (minimum) and 6.31 cm (maximum), with an average of 5.173 cm.

The length of the anal base (lA), measured in a straight line between the foreside of the first ray and posterior side of the last ray of the anal fin, varied between 2.5 cm (minimum) and 5.25 cm (maximum), with an average of 3.93 cm.

The predorsal distance (pD), measured from the tip of the mouth to the foreside of the first ray of the dorsal fin, varied between 1.6 cm (minimum) and 4.7 cm (maximum), with an average of 2.64 cm.

The preventral distance (Pv), measured from the tip of the mouth to the foreside of the first ray of the ventral fin varied between 1 cm (minimum) and 2.9 cm (maximum) with an average of 1.84 cm.

The preanal distance (pA), measured from the tip of the mouth to the foreside of the first ray of the fin, varied between 3.2 cm (minimum) and 5.8 cm (maximum) with an average of 4.26 cm.

Tab. 1 - The biometrical data on the *Liparis liparis* population in Spitsbergen Island

Nr ex.	TL (cm)	SL (cm)	H (cm)	h (cm)	lc (cm)	hc (cm)	Oh (cm)	prO (cm)	poO (cm)	io (cm)	lD (cm)	lA (cm)	pD (cm)	pV (cm)	pA (cm)
1.	5.2	4.5	1.25	0.35	1.4	1.1	0.3	0.53	0.7	0.51	3.1	2.5	1.63	1	2.1
2.	9.0	7.9	1.9	0.42	2.35	2.18	0.5	0.91	1.2	0.8	5.15	4.6	2.6	2.41	4.05
3.	6.52	5.78	1.32	0.4	1.78	1.6	0.45	0.7	0.92	0.6	4.06	3.28	1.8	1.7	2.9
4.	8.22	7.12	2	0.5	2.1	1.9	0.4	0.85	1.1	0.74	5.1	4.3	2.5	1.4	3.29
5.	8.5	7.52	2.1	0.41	7.1	2.07	0.5	0.88	1.1	0.86	5.4	4.31	2.6	1.45	3.35
6.	7.25	6.3	1.51	0.35	2	1.8	0.4	0.75	1	0.7	4.5	3.53	2.2	1.94	3.31
7.	7.46	6.44	1.71	0.40	1.91	1.86	0.45	0.78	1	0.7	2.18	3.6	2.1	1.95	3.45
8.	7.96	7.11	1.74	0.4	2.1	2	0.41	0.88	1.08	0.8	4.82	3.97	2.1	2.16	3.67
9.	8.9	7.89	2.1	0.49	2.2	2.25	0.4	0.8	1.2	0.86	5.6	4.2	2.53	2.2	3.88
10.	7.68	6.78	1.71	0.41	1.89	1.92	0.4	0.68	1.19	0.71	4.53	3.71	4.7	1.81	3.51
11.	7.9	6.9	1.55	0.4	2.05	2.05	0.4	0.75	1.1	0.75	4.66	3.62	2.35	2.9	3.33
12.	9	8	2.3	0.5	2.3	2.02	0.36	1	1.2	0.8	5.52	4.37	2.73	1.96	4.1
13.	7	6.1	1.8	0.4	1.9	1.7	0.41	0.78	0.97	0.7	4.05	3.7	2.3	1.2	3.1
14.	9	7.84	2.2	0.4	2.2	2.2	0.45	0.85	1.21	0.9	5.6	4.4	2.75	1.91	3.83
15.	7.25	6.25	1.61	0.4	2.12	1.8	0.36	0.73	1	0.61	4.56	4.05	2.2	1.25	2.8
16.	7.4	6.46	1.62	0.48	1.9	1.8	0.36	0.9	1	0.7	4.5	3.7	2.4	1.8	3.9
17.	7.5	6.5	1.7	0.4	2	1.9	0.4	0.74	1.1	0.67	4.61	3.42	2.12	1.92	3.78
18.	6.1	5.3	1.4	0.3	1.56	1.5	0.31	0.6	0.75	0.53	3.68	2.9	1.7	1.38	3
19.	5.8	5.1	1.1	0.32	1.4	1.4	0.32	0.6	0.7	0.5	3.45	2.9	1.6	1.5	2.6
20.	6.9	5.91	1.6	0.32	1.91	1.68	0.4	0.66	0.91	0.6	-	3.62	2.18	1.95	-
21.	9	7.89	2	0.44	2.31	2.1	0.43	0.9	1.15	0.94	3.8	4.12	4.6	1.5	4.4
22.	11	9.5	2.3	0.48	2.8	2.4	0.5	1.1	1.4	0.9	6.31	4.85	3.3	2.52	5.1
23.	11	9.8	2.7	0.62	2.9	2.8	0.5	1.16	1.4	1	5.9	4.91	4.7	2.9	5.8
24.	10.25	9.1	2.35	0.5	2.6	2.4	0.5	0.9	1.52	1	6.1	5.25	3.1	2.5	5.1
25.	9.52	8.35	2.3	0.52	2.56	2.42	0.48	1	1.4	1.1	6	4.2	3.1	1.8	4.23
26.	9.71	8.53	2.42	0.5	2.6	2.3	0.5	1.1	1.5	0.9	6.25	5.1	3.4	1.96	4.22
27.	8	7.25	2.02	0.42	2	1.92	0.4	0.9	1.12	0.9	4.95	3.8	2.7	1.5	3.6
28.	6.3	5.7	1.52	0.32	1.72	1.45	0.3	0.7	0.9	0.65	3.32	3.1	2.2	1.5	3.2
29.	7.8	7	1.9	0.41	2	2.06	0.36	0.8	0.98	0.71	4.3	3.9	2.6	1.55	3.4
30.	8.1	7.2	1.6	0.45	2.1	1.9	0.36	0.7	1.05	0.7	4.8	4.02	2.6	1.78	3.55

Tab. 2 - The minimum, maximum and average values of the metrical characteristics of *Liparis liparis* population in Spitsbergen Island

Analyzed character	Minimum value (cm)	Maximum value (cm)	Average value (cm), (n=30)
Total length (TL)	5.2	11	8.040667
Standard length (SL)	4.5	9.8	7.067333
Maximum length of the body (H)	1.1	2.7	1.844333
Minimum height of the body (h)	0.3	0.62	0.423667
The length of the head (lc)	1.4	7.1	2.258667
The height of the head (hc)	1.1	2.8	1.949333
Diameter of the eye (Oh)	0.3	0.5	0.410333
Preorbital distance (prO)	0.53	1.16	0.821
Postorbital distance (poO)	0.7	1.52	1.095
Interorbtal distance (io)	0.5	1.1	0.761333
Length of the dorsal base (lD)	3.32	6.31	5.173
Length of the anal base (lA)	2.5	5.25	3.931
Predorsal distance (pD)	1.6	4.7	2.646333
Preventral distance (pV)	1	2.9	1.843333
Preanal distance (pA)	3.2	5.8	4.26

Analiza caracterelor meristice:

The number of the fin's rays varied between 28 (1 individual) and 42 (2 individuals), those with 39 rays having the highest frequency (10 individuals, representing 33.33% of the total number of analyzed individuals). Still referring to the frequency, we also found cases of 40 and 41 rays (five cases for each situation, representing 16.66 % of the cases). Other values were of 32, 36 and 38 rays (one case each), each of them representing 3.33 % of the analyzed individuals. Together with the minimum and maximum values for the dorsal rays, we also noticed values of 35, 37 and 42 rays (two cases each). (see Table 3).

The number of rays of the anal fin, varied between 29 (1 individual) and 37 (1 individual), the individuals with 30 rays being the most frequent (17 individuals, representing 56.66 % of the total of individuals analyzed). Other values include 32 and 34 rays (4 cases each), each representing 13.33 % of the total number of individuals. Together with the minimum and maximum values for the anal fin's ray, values of 30, 35 and 36 rays have also been noticed (one case each) (see Table 3).

Taxonomically speaking, this characteristic has a great significance for determining the *Liparis* species. We could establish that the analyzed individuals varied between the limits accepted in the literature for *Liparis liparis*, meaning 25-37 rays in the anal fin, (Muus & Nielsen, 1999).

The number of rays in the pectoral fin, varied between 31 and 37, without any taxonomical significance.

The lowest variability, which means the most constant meristic characteristics, could be found in the *number of the ventral rays*, which has constantly been of 13 rays for all the 30 analyzed individuals, therefore with a 100% frequency, same as *the number of the caudal rays* which has been of a constant 10 for all the analyzed individuals.

Tab. 3 - Meristic characteristics' values for the *Liparis liparis* population in Spitsbergen Island

Nr. Ex.	Number of dorsal rays	Number of anal rays	Number of pectoral rays	Number of ventral rays	Number of caudal rays
1.	37	33	34	13	10
2.	41	32	34	13	10
3.	40	32	34	13	10
4.	38	34	34	13	10
5.	39	33	34	13	10
6.	39	33	36	13	10
7.	40	33	34	13	10
8.	39	33	36	13	10
9.	42	33	35	13	10
10.	40	35	32	13	10
11.	39	33	34	13	10
12.	40	32	34	13	10
13.	41	33	31	13	10
14.	39	33	34	13	10
15.	39	32	34	13	10
16.	39	33	32	13	10
17.	39	33	33	13	10
18.	39	34	35	13	10
19.	41	34	32	13	10
20.	41	33	36	13	10
21.	32	30	33	13	10
22.	28	33	34	13	10
23.	35	36	37	13	10
24.	35	29	31	13	10
25.	39	37	32	13	10
26.	41	34	32	13	10
27.	42	33	33	13	10
28.	36	33	37	13	10
29.	37	33	32	13	10
30.	40	33	32	13	10

Conclusions

From the analysis of the meristic characteristics we established a great variability for the number of rays of the fin. Thus, the number of the dorsal rays varied between 28 and 42 rays, with the highest frequency for individuals with 39 rays (33.33% of the analyzed individuals). The number of the anal rays varied between 29 and 37, with the highest frequency for individuals with 30 rays (56.66 % of the analyzed individuals).

Taxonomically speaking, the number of the anal rays has a significant contribution in the determination of *Liparis* species. We established that the analyzed individuals varied between the limits accepted in the literature for *Liparis liparis*, meaning 25-37 rays in the anal fin, (Muus & Nielsen, 1999).

The lowest variability, which means the most constant meristic characteristics, could be found in the *number of the ventral rays*, which has constantly been of 13 rays for all the 30 analyzed individuals, therefore with a 100% frequency, same as *the number of the caudal rays* which has been of a constant 10 for all the analyzed individuals.

Rezumat

In lucrare am prezentat rezultatele analizei biometrice a 30 de exemplare de *Liparis liparis* (Pisces: Liparididae) colectate din Insula Spitsbergen, Arhipelagul Svalbard, Norvegia, in cadrul expediției Spitsbergen II. Am înregistrat 15 caractere biometrice şi am stabilit limitele de variabilitate ale acestor caractere pentru populația studiată. Am analizat de asemenea şi 5 caractere meristice şi am urmărit variabilitatea acestora.

References

1. BĂNĂRESCU P., 1964 – *Fauna Republicii Populare Române, vol. 13, Pisces. Osteichthyes (peşti ganoizi şi osoşi)*. Edit Academiei R.P.R. 957 p.
2. MOYLE P., CECH J., 2004 – *Fishes, An introduction to the Ichthyology*. Fifth Edition, 726 p.
3. MUUS B., DAHLSTRÖM P., 1978 – *Meeresfische der Ostsee, der Nordsee, des Atlantiks*. BLV Verlagsgesellschaft, München. 244 p.
4. MUUS B., NIELSEN J., 1999 – *Sea fish*. Scandinavian Fishing Year Book, Hedehusene, Denmark. 340 p.
5. ROBINS C.R., RAY G.C., 1986 – *A field guide to Atlantic coast fishes of North America*. Houghton Mifflin Company, Boston, U.S.A. 354 p.
6. STEIN D., ABLE K., 1986 – *Liparididae*, p. 1275-1283, *in* WHITEHEAD P.J.P., BAUCHOT M.-L., HUREAU J.-C., NIELSEN J., TORTONESE E. (eds.) *Fishes of the North-eastern Atlantic and the Mediterranean*. UNESCO, Paris. Vol. III.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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BIOMETRICAL STUDY OF *MYOXOCEPHALUS SCORPIOIDES* (FABRICIUS, 1780) (PISCES: COTTIDAE) IN SPITSBERGEN ISLAND, SVALBARD ARCHIPELAGO, NORWAY [RESULTS OF THE EXPEDITION „SPITSBERGEN II" 1991]

NICOLAE CRĂCIUN*

ABSTRACT

CRĂCIUN N., 2006 – Biometrical study of *Myoxocephalus scorpioides* (Fabricius, 1780) (Pisces: Cottidae) in Spitsbergen Island, Svalbard Archipelago, Norway. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 389-394.

We analyzed 60 individuals of *Myoxocephalus scorpioides* (Pisces: Cottidae) collected in Spitsbergen Island, Svalbard Archipelago, Norway, within the Spitsbergen II expedition, when we recorded 14 biometrical characteristics and we established the variability limits for the analyzed population. We also analyzed 6 meristic characteristics and their variability.

Key words: Svalbard Archipelago, Spitsbergen Island, *Myoxocephalus scorpioides*, biometry.

Introduction

From a systematic point of view, *Myoxocephalus scorpioides* (Fabricius, 1780) belongs to the Order Scorpaeniformes, Suborder Cottoidei, and Family Cottidae.

Fishes in Cottidae Family are of small size, with a thick body, more or less dorso-ventrally down casted in the foreside, narrow and laterally compressed in the posterior side; the body is either nude or covered in little spiky plates and sometimes partially covered in scales. The head is dorso-ventrally down casted, often with spikes, but not covered by plates. The mouth is concluded, wide, with no whiskers. It has two dorsal fins, sometimes partially grown together, the first one with 5-18 rays; the anal fin is similar to the second dorsal, with no spikes, truncated or round.

Myoxocephalus scorpioides is characterized by the presence of three preopercular spikes. The soft rays of the dorsal, pectoral and anal fins are not branched out. The lateral line has no bone plates, but three series of 35-56 scales each. The caudal peduncle is relatively long and thin.

Literature gives us a (total) number of the spikes in the dorsal fin of 8-9; the number of the soft rays in the dorsal fin of 14-17; the number of spikes in the anal fin of 0; the number of soft rays in the anal fin of 11-13. The caudal fin is round. The upper part of the body has a dark-brown color (more pale for females), the sides present dark transversal stripes (especially for the males, which have a dark line and irregular white or silver spots under the pectoral fins and above the anal one); the ventral side of the body and the abdomen have dark spots for males and in the nuptial period they have a white stripe with orange shades starting from the base of the pelvian fins to the anus; the lower lip is spotted for males (and dark for females); the abdominal fins are crossed by 2-3 dark stripes; the pectoral fins are dark brown or black for the males; they are crossed by 4-5 series of light spots (Robins & Ray, 1986).

Myoxocephalus scorpioides lives in the intertidal waters, where they feed on shell fish, on the rocks covered in algae (especially *Fucus* sp., at depths of 0-25 m, with temperatures that can reach 5 to 8 ºC in the summer and below 0ºC in the winter.

The maximum dimensions reached are up to 30 cm, with an average of 12-20 cm in length. The spawns can reach up to 1.3 mm in diameter, and they are laid on or close to the substratum. There aren't too many known aspects regarding this species' biology, but it is well known their capacity of tolerating temperatures close to freezing. In order to survive under water, *Myoxocephalus scorpioides* has to be capable of surviving in low temperatures, of -1.4 ºC. When the temperature of the water falls,

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the concentration of a protein in their blood grows, and this prevents freezing. This protein prevents the forming of the ice in the fish's tissue and allows it to resist to temperatures up to -2ºC.

Its areal extends from the south-east of Greenland's coasts, the west of the North Atlantic (from Labrador to Sf. Lawrence), the arctic seas and the north of the Pacific Ocean (Fedorov, 1986).

Material şi metodă

Between the 24th of July and the 22nd of august 1991, we have been analyzing from a biometrical point of view a population of *Myoxocephalus scorpioides* from Spitsbergen Island, (Svalbard Archipelago, Norway), taking into consideration both the morfometric and the meristic characteristics.

The analyzed biometrical characteristics were: the total length (TL), Standard Length (SL), minimum height of the body (h), the length of the caudal peduncle (lpc), the length of the head (lc), the height of the head (hc), the diameter of the eye (Oh), the preorbital distance (prO), the postorbital distance (poO), the interorbital distance (io), the predorsal distance (pD), the preventral distance (pV) and the preanal distance (pA).

Among the meristic characteristics, we analyzed the number of the rays from the dorsal fin, the anal fin, the pectoral fin, the ventral fin and the caudal fin and the number of scales in the lateral line.

Fig. 4 - *Myoxocephalus scorpioides* (Fabricius, 1780), dorsal view (left) and ventral view (right), (original), collected in the Spitsbergen Island, Svalbard Archipelago, Norway.

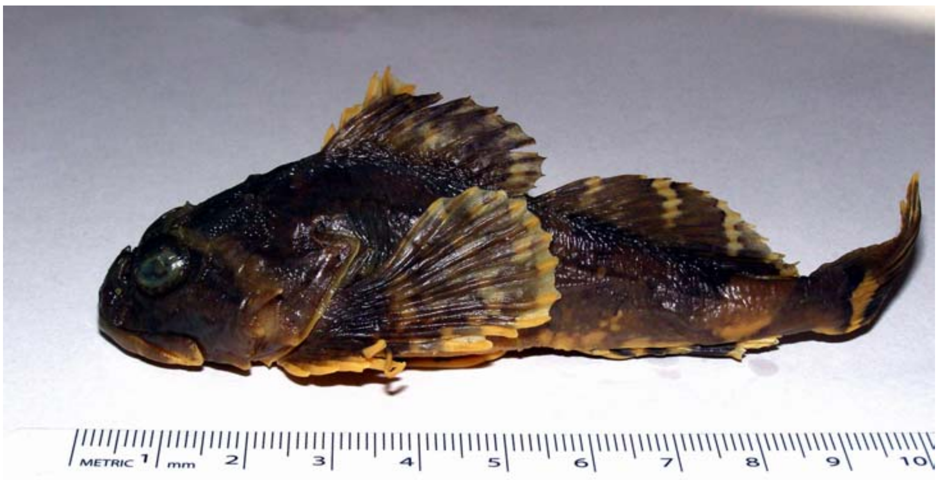

Fig. 5 - *Myoxocephalus scorpioides* (Fabricius, 1780), side view (original), collected **Spitsbergen Island, Svalbard Archipelago, Norway.**

Results and discussions

The value of the main metrical characters which have been analyzed can be found in Table 1 and the minimum and maximum values and also the average value can be found in Table 2.

The total length (TL), measured in straight line from the tip of the mouth to the tip of the caudal fin, varies between 2.9 cm (minimum) and 15.32 cm (maximum) , with an average of 8.82 cm.

The standard length (SL), or the length of the body, measured from the tip of the mouth to the end of the body's scale layer, varies between 2.3 cm (minimum) and 12.85 cm (maximum), with an average of 7.43 cm.

The minimum height of the body (h), measured at the caudal peduncle level, ranged between 0.25 cm (minimum) and 0.8 cm (maximum), with an average of 0.53 cm.

The length of the caudal peduncle (lpc), measured from the vertical of the posterior side of the anal fin to the end of the scaled layer of th body, ranged between 0.39 cm (minimum) and 6.5 cm (maximum), with an average of 1.24 cm.

The length of the head (lc) measured from the tip of the mouth to the posterior side of the opercular apparatus, varied between 0.83 cm (minimum) and 5.12 cm (maximum), with an average of 2.9 cm.

The height of the head (hc), the maximum height varied between 0.81 cm (minimum) and 4.68 cm (maximum), with an average of 2.66 cm.

The diameter of the eye (Oh), measured in longitude, varied between 0.3 cm (minimum) and 1.55 cm (maximum), with an average of 0.69 cm.

The preorbital distance (prO) measured from the tip of the mouth to the foreside of the eye, varied between 0.27 cm (minimum) and 1.4 cm (maximum) with an average of 0.83 cm.

The postorbital distance (poO) measured from the vertical line of the posterior side of the eye to the side of the gill membrane varied between 0.43 cm (minimum) and 2.6 cm (maximum) with an average of 1.53 cm.

The interorbital distance (io), the minimal distance between the orbits, measured in a straight line on the dorsal side of the head, varied between 0.22 cm (minimum) and 0.7 cm (maximum), with an average of 0.42 cm.

The predorsal distance (pD), measured from the tip of the mouth to the foreside of the first ray of the dorsal fin, varied between 0.8 cm (minimum) and 4.6 cm (maximum), with an average of 2.73 cm.

The preventral distance (Pv), measured from the tip of the mouth to the foreside of the first ray of the ventral fin varied between 0.85 cm (minimum) and 5.1 cm (maximum) with an average of 2.83 cm.

The preanal distance (pA), measured from the tip of the mouth to the foreside of the first ray of the fin, varied between 1.22 cm (minimum) and 8.3 cm (maximum) with an average of 4.56 cm.

Tab.1 - Biometrical data on *Myoxocephalus scorpioides* population in Spitzbergen Island

Nr.	TL (cm)	SL (cm)	H (cm)	h (cm)	lpc (cm)	lc (cm)	hc (cm)	Oh (cm)	prO (cm)	poO (cm)	io (cm)	pD (cm)	pV (cm)	pA (cm)
1.	11.2	9.65	2.4	0.68	1.42	3.95	3.6	0.8	1.22	2	0.5	3.12	4.62	6.1
2.	6.65	5.68	1.5	0.45	0.85	2.4	2.1	0.55	0.6	1.2	0.3	2	3.68	3.6
3.	8.7	7.42	1.85	0.5	1.15	2.9	2.3	0.7	0.4	1.6	0.42	2.9	3.1	4.8
4.	8.8	8.6	2.3	0.6	1.2	3.5	3.21	0.8	1	2	0.6	3.4	2.9	5.45
5.	7	5.5	1.6	0.42	0.71	2.3	1.95	0.5	0.6	1.2	0.35	1.95	2.5	3.75
6.	13.3	11	3	0.8	1.7	4.5	3.9	1	1.3	2.4	0.65	4.4	3.8	7.3
7.	11.5	9.4	2.7	0.7	1.5	3.7	3.5	0.88	1.2	2.2	0.55	3.55	3.2	5.75
8.	11.5	9.55	2.6	0.7	0.9	3.85	3.5	0.8	1.1	2.1	0.5	3.4	4.3	6.4
9.	13.7	11.7	2.5	0.75	1.65	4.5	4.2	1.55	1.4	2.45	0.6	4.4	3.4	7.3
10.	7.36	6.1	1.6	0.45	1	2.5	2.35	0.5	0.75	1.3	0.3	2.15	2	3.75
11.	14.6	12.35	3.17	0.78	2.03	5	4.58	1.02	1.22	2.52	0.68	4.5	5	7.8
12.	9.06	7.55	1.99	0.55	6.5	2.82	2.52	0.55	0.75	1.4	0.42	2.6	3.2	4.6
13.	15.32	12.85	3.5	0.76	1.32	5.12	4.68	1.05	1.25	2.6	0.7	4.6	5.1	8.3
14.	7.48	6.1	1.52	0.42	1.1	2.5	2.5	0.51	0.63	1.32	0.42	2.3	1.9	3.7
15.	11.7	9.7	2.52	0.68	0.8	3.82	3.81	0.88	1.23	2.1	0.41	3.5	4.2	1.22
16.	8.8	7.32	1.88	0.52	1.1	3	2.7	0.6	0.72	1.72	0.5	2.8	2.5	4.7
17.	11.85	9.87	2.42	0.65	1.5	3.95	3.85	0.84	1.25	2.06	0.62	3.9	3.52	6.52
18.	8.7	7.4	2	0.5	1	2.5	2.7	0.68	0.96	0.93	0.4	2.75	3.92	4.9
19.	9.3	7.89	2.1	0.55	1.2	2.92	2.7	0.7	0.91	1.02	0.45	2.85	3.6	3.6
20.	7	5.84	1.68	0.44	0.8	2.4	2.1	0.55	0.7	1.25	0.38	2.1	2.4	3.86
21.	11.55	9.5	2.5	0.65	1.42	3.6	3.2	0.72	1	1.92	0.6	3.6	3.1	5.7
22.	10	9.4	1.7	0.66	1.25	3.1	2.9	0.7	1	1.78	0.4	2.9	2.4	5.3
23.	8.8	7.28	1.95	0.5	0.8	2.8	2.45	0.68	0.9	1.5	0.45	2.65	3.2	4.85
24.	8.22	6.8	1.8	0.5	0.9	2.62	2.36	0.6	0.9	1.3	0.36	2.4	2.92	4.4
25.	7.6	6.3	1.65	0.5	1	2.4	2.36	0.6	0.9	1.3	0.38	2.58	2.2	3.9

26.	7.3	6.2	1.54	0.42	0.8	2.35	2.1	0.5	0.6	1.15	0.38	2.1	2.55	4
27.	7.2	6	1.5	0.42	0.96	2.3	2.06	0.53	0.6	1.25	0.4	2.3	2.15	3.84
28.	9.12	7.7	1.82	0.55	1.1	3.08	2.8	0.75	1	1.58	0.5	2.9	2.88	5
29.	9.75	8.3	2.26	0.6	1.3	3.28	2.9	0.76	0.91	1.7	0.48	3.1	2.75	5.2
30.	7.7	6.52	1.85	0.5	1.02	2.5	2.35	0.6	0.9	1.4	0.32	2.35	2.52	4.18
31.	8.8	7.62	1.9	0.5	1.2	2.7	2.75	0.7	0.75	1.41	0.42	2.53	2.51	4.6
32.	6.48	5.15	1.3	0.4	0.7	1.9	1.9	0.5	0.5	1.11	0.3	1.75	2.06	3.4
33.	6.5	5.4	1.52	0.4	0.83	2	2.03	0.57	0.66	1.1	0.38	2.12	1.78	3.3
34.	7.23	6.16	1.6	0.5	0.86	2.6	2.46	0.6	0.8	1.32	0.4	2.93	1.92	3.6
35.	7.52	6.18	1.5	0.48	1.02	2.4	2.4	0.62	0.68	1.35	0.4	2.31	1.86	3.8
36.	6.4	5.3	1.32	0.35	0.7	2.08	2.1	0.52	0.58	1.05	0.3	1.95	1.95	3.31
37.	6.08	5.1	1.3	0.4	0.8	2.1	1.4	0.6	0.51	1.04	0.31	2	3.08	1.6
38.	5.3	4.5	1.02	0.38	0.7	1.75	1.6	0.5	0.51	0.9	0.3	2.05	1.38	2.7
39.	5	4.12	1.15	0.31	0.6	1.58	1.5	0.47	0.4	0.78	0.25	1.41	1.5	2.5
40.	2.9	2.3	0.67	0.25	0.39	0.83	0.81	0.3	0.27	0.43	0.22	0.8	0.85	1.5
41.	11.2	9.65	2.4	0.68	1.42	3.95	3.6	0.8	1.22	2	0.5	3.12	4.62	6.1
42.	6.65	5.68	1.5	0.45	0.85	2.4	2.1	0.55	0.6	1.2	0.3	2	3.68	3.6
43.	8.7	7.42	1.85	0.5	1.15	2.9	2.3	0.7	0.4	1.6	0.42	2.9	3.1	4.8
44.	8.8	8.6	2.3	0.6	1.2	3.5	3.21	0.8	1	2	0.6	3.4	2.9	5.45
45.	7	5.5	1.6	0.42	0.71	2.3	1.95	0.5	0.6	1.2	0.35	1.95	2.5	3.75
46.	13.3	11	3	0.8	1.7	4.5	3.9	1	1.3	2.4	0.65	4.4	3.8	7.3
47.	11.5	9.4	2.7	0.7	1.5	3.7	3.5	0.88	1.2	2.2	0.55	3.55	3.2	5.75
48.	11.5	9.55	2.6	0.7	0.9	3.85	3.5	0.8	1.1	2.1	0.5	3.4	4.3	6.4
49.	13.7	11.7	2.5	0.75	1.65	4.5	4.2	1.55	1.4	2.45	0.6	4.4	3.4	7.3
50.	7.36	6.1	1.6	0.45	1	2.5	2.35	0.5	0.75	1.3	0.3	2.15	2	3.75
51.	6.2	5.2	1.22	0.35	0.7	2	1.08	0.5	0.6	1.02	0.3	1.9	1.62	3.2
52.	7.2	5.8	1.5	0.45	0.95	2.2	1.9	0.55	0.66	1.18	0.34	2.2	1.7	3.42
53.	5.9	4.8	1.35	0.4	0.7	1.86	1.8	0.5	0.55	1	0.25	1.82	2.1	3.2
54.	9.4	7.8	2	0.55	1.2	3.1	2.8	0.71	0.9	1.6	0.41	2.75	2.48	4.7
55.	9.3	8.82	2.05	0.58	1.4	2.7	2.9	0.68	1.02	1.55	0.5	2.7	2.72	4.9
56.	7.95	6.85	1.7	0.5	1.4	2.8	2.42	0.6	0.65	1.4	0.4	2.32	2.26	3.9
57.	6.75	5.6	1.35	0.4	0.9	2.36	2	0.5	0.65	1.2	0.3	2.2	1.9	3.7
58.	8.1	6.4	1.8	0.5	1.1	2.46	2.42	0.6	0.65	1.35	0.35	2.4	2.6	4.35
59.	8.1	6.4	1.6	0.5	1.15	2.32	2.55	0.55	0.7	1.4	0.4	2.3	2.2	4.1
60.	7.38	6.22	1.8	0.5	0.9	2.26	2.3	0.62	0.7	1.3	0.4	2.3	2.5	3.8

Tab. 2 - Minimum, maximum and average values of the metrical characteristics of *Myoxocephalus scorpioides* population analyzed in Spitsbergen Island

Analyzed character	Minimum value (cm)	Maximum value (cm)	Average value (cm), (n=60)
Total length (TL)	2.9	15.32	8.825484
Standard length (SL)	2.3	12.85	7.434516
Maximum length of the body (H)	0.67	3.5	1.92371
Minimum height of the body (h)	0.25	0.8	0.532258
Length of the caudal peduncle (lpc)	0.39	6.5	1.244355
The length of the head (lc)	0.83	5.12	2.906613
The height of the head (hc)	0.81	4.68	2.668548
Diameter of the eye (Oh)	0.3	1.55	0.693871
Preorbital distance (prO)	0.27	1.4	0.836833
Postorbital distance (poO)	0.43	2.6	1.535806
Interorbtal distance (io)	0.22	0.7	0.429677
Predorsal distance (pD)	0.8	4.6	2.734333
Preventral distance (pV)	0.85	5.1	2.837581
Preanal distance (pA)	1.22	8.3	4.565645

Tab. 3 - Meristic characteristics' values for the *Myoxocephalus scorpioides* population in Spitsbergen Island

Nr. Ex.	Number of dorsal rays	Number of anal rays	Number of pectoral rays	Number of ventral rays	Number of caudal rays	Lateral line
1.	10/15	12	16	3	15	40/40
2.	10/16	13	16	3	16	41/40
3.	9/15	12	17	3	17	40/41
4.	10/16	13	17	3	16	42/42
5.	10/16	13	18	3	16	40/40
6.	10/16	13	16	3	14	41/42
7.	11/16	13	17	3	16	40/41
8.	9/17	12	16	3	18	40/40
9.	10/16	13	16	3	18	42/42
10.	10/16	13	17	3	14	40/41
11.	11/15	13	17	3	14	40/40
12.	10/16	13	15	3	18	42/39
13.	10/15	12	17	3	14	41/36
14.	10/17	13	16	3	14	39/39
15.	11/16	13	17	3	17	41/46
16.	11/16	13	16	3	13	41/39
17.	11/15	13	18	3	13	40/40
18.	10/16	14	17	3	12	40/39
19.	12/16	12	16	3	12	39/39
20.	10/16	13	17	3	17	42/40
21.	11/16	13	17	3	13	44/44
22.	9/15	13	17	3	13	41/40
23.	10/17	13	15	3	16	41/42
24.	10/16	13	17	3	17	41/44
25.	10/16	14	17	3	15	40/39
26.	11/11	13	16	3	16	40/41
27.	10/15	12	16	3	17	39/38
28.	11/16	13	17	3	17	39/39
29.	11/15	14	16	3	16	41/41
30.	10/16	13	16	3	25	41/45
31.	10/17	14	17	3	16	40/43
32.	9/16	13	17	3	16	39/42
33.	12/16	12	16	3	15	39/40
34.	10/15	13	17	3	15	40/42
35.	9/16	12	17	3	15	42/41
36.	10/16	12	15	3	16	42/42
37.	10/15	13	16	3	14	42/41
38.	10/15	12	17	3	15	43/41
39.	9/16	13	16	3	14	45/43
40.	10/16	16	13	3	17	37/38
41.	10/15	12	16	3	15	40/40
42.	10/16	13	16	3	16	41/40
43.	9/15	12	17	3	17	40/41
44.	10/16	13	17	3	16	42/42
45.	10/16	13	18	3	16	40/40
46.	10/16	13	16	3	14	41/42
47.	11/16	13	17	3	16	40/41
48.	9/17	12	16	3	18	40/40
49.	10/16	13	16	3	18	42/42
50.	10/16	13	17	3	14	40/41
51.	8/14	13	16	3	12	38/36
52.	9/16	13	17	3	16	36/37
53.	9/15	12	17	3	15	39/35
54.	11/17	14	16	3	17	42/41
55.	10/17	12	17	3	20	44/42

56.	10/17	10	17	3	14	41/42
57.	10/17	13	17	3	14	39/38
58.	9/16	12	17	3	15	40/39
59.	11/16	13	16	3	23	40/39
60.	10/15	13	17	3	18	39/39

Analyze of the meristic characteristics: (see Table 3)

The number of rays in the dorsal I, varied between 8 (1 individual) and 12 (2 individuals), those with 10 rays having the highest frequency (34 individuals, representing 56.66% of the total number of analyzed individuals). Still referring to the frequency, we also found cases of 11 rays (12 cases for each situation, representing 20 % of the cases) and 9 rays (11 cases), representing 18.33 % of the analyzed individuals. (see Table 3).

The number rays ion the dorsal II, varied between 11 (1 individual) and 17 (9 individuals), those with 16 rays having the highest frequency (34 individuals, representing 56.66% of the total number of analyzed individuals). Still referring to the frequency, we also found cases of 15 rays (15 cases for each situation, representing 25 % of the cases). Together with the minimum and maximum values for the dorsal rays, we also noticed one case of 12 rays (see Table 3).

The number of rays of the anal fin, varied between 10 (1 individual) and 16 (1 individual), the individuals with 13 rays being the most frequent (37 individuals, representing 61.66 % of the total of individuals analyzed). Other values include 12 rays (16 cases each), each representing 26.66 % of the total number of individuals. There were also noticed cases of rays (4 individuals, representing 8.33%) (see Table 3).

The number of rays of the pectoral fins, varied between 13 (1 individual) and 18 (3 individual), the individuals with 17 rays being the most frequent (30 individuals, representing 50 % of the total of individuals analyzed). Other values include 16 rays (23 cases each), each representing 38.33 % of the total number of individuals.

The number of rays of the ventral fins has been constant throughout the 60 individuals analyzed, with only 3 rays.

The number of radii of the caudal fin, varied between 12 and 23, the individuals with 16 rays being the most frequent (15 individuals, representing 25 % of the total of individuals analyzed). Other high frequencies include values of 15 or 17 rays (9 cases each), each representing 15 % of the total number of individuals.

The lateral line varied between 36 and 44 scales.

Conclusions

From the analysis of the meristic characteristics we established a great variability for the number of rays of the fin. Thus, the number of rays in the first dorsal varied between 8 and 12 rays, with the highest frequency for individuals with 10 rays (56.66% of the analyzed individuals). The number of rays in the II dorsal varied between 11 and 17 rays, with the highest frequency for individuals with 16 rays (56.66% of the analyzed individuals). The number of rays in the anal fin varied between 10 and 16, with the highest frequency for individuals with 13 rays (61.66 % of the analyzed individuals). The number of the pectoral fin rays varied between 13 and 18, with the highest frequency for individuals with 17 rays (50 % of the analyzed individuals). The number of rays of the ventral has been constant throughout the 60 individuals analyzed, with only 3 rays. The number of the caudal fin rays varied between 12 and 23, with the highest frequency for individuals with 16 rays and the lateral line varied between 36 and 44 scales.

We established that the analyzed individuals varied between the limits accepted in the literature for *Myoxocephalus scorpioides* (Fabricius, 1780).

Rezumat

In lucrare am prezentat datele biometrice obținute de la 60 de exemplare de *Myoxocephalus scorpioides* (Pisces: Cottidae) colectate din Insula Spitsbergen, Arhipelagul Svalbard, Norvegia, in cadrul expediției Spitsbergen II. Am înregistrat 14 caractere biometrice şi am stabilit limitele de variabilitate ale acestor caractere pentru populația studiată. Am analizat de asemenea şi 6 caractere meristice şi am urmărit variabilitatea acestora.

References

1. BĂNĂRESCU P., 1964 – *Fauna Republicii Populare Române, vol. 13, Pisces. Osteichthyes (pești ganoizi și osoşi)*. Edit Academiei R.P.R. 957 p.
2. FEDOROV V., 1986 – *Cottidae*, *in* WHITHEAD P., BAUCHOT M., HUREAN J., NIELSEN J., TORTONESE E., *Fishes of the North-eastern Atlantic and the Mediterranean*, Vol III, pg. 1016-1472.
3. ROBINS C.R., RAY G.C., 1986 – *A field guide to Atlantic coast fishes of North America*. Houghton Mifflin Company, Boston, U.S.A. 354 p.

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EXPERIMENTAL MODEL FOR *CARASSIUS* GENERA INDIVIDUALS' PHYLOGENY ESTABLISHMENT ON MOLECULAR BASIS

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ABSTRACT

GORGAN D. L., 2006 - Experimental model for *Carassius* genera individuals' phylogeny establishment on molecular basis. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 395-400.

Evolutive modifications from the DNA's level are more complex than those from protein sequences, because there are more many types of DNA, like codifying and uncodifying regions, exons, introns, terminal regions, repetitive regions and insertion sequences. All changes made by mutations at the DNA level, varies in function of appearance region. Even if we consider a single codifying region, the model of nucleotide substitution in first, second and third position of the same codon is different. Further more, many regions are exposed to natural selection more than others, fact which contributes to evolution model variation for different DNA regions.

In present paper, our purpose was to define an experimental model for detecting and monitoring the *Carassius* genera individuals' phylogenetic directions.

Keywords: *Carassius,* DNA, molecular, markers, phylogeny

Introduction

To extract biological information from enormous strings of As, Cs, Ts, and Gs, functional genomics depends on computational analysis of the sequence data. It is unrealistic to expect that every single gene or even a majority of the genes found in the sequenced genomes would ever be studied experimentally. However, using the relatively cheap and fast computational approaches, it is usually possible to reliably predict the protein-coding regions in the DNA sequence with reasonable (albeit varying) confidence and to get at least some insight into the possible functions of the encoded proteins. Such an analysis proves valuable for many branches of biology, in large part, because it assists in classification and prioritization of the targets for future experimental research.

Computations on genomes are inexpensive and fast compared to large-scale experimentation, but it would be a mistake to equate this with 'easy'. The history of annotation and comparative analysis of the first sequenced genomes convincingly (and sometimes painfully) shows that the quality and utility of the final product critically depend on the employed methods and the depth of interpretation of the results obtained by computer methods. Unfortunately, errors produced in the course of computer analysis are propagated just as easily as real discoveries, which make development of reliable protocols and crystallization of the accumulating experience of genome analysis in easily accessible forms particularly important (Koonin & Galperin, 2002).

Traditional views on deep evolutionary events have been seriously challenged over the last few years, following the identification of major pitfalls affecting molecular phylogeny reconstruction. Here we describe the principally encountered artifacts, notably long branch attraction, and their causes (i.e., difference in evolutionary rates, mutational saturation, compositional biases). Additional difficulties due to phenomena of biological nature (i.e., lateral gene transfer, recombination, hidden paralogy) are also discussed. Moreover, contrary to common beliefs, we show that the use of rare genomic events can also be misleading and should be treated with the same caution as standard molecular phylogeny. The universal tree of life, as described in most textbooks, is partly affected by tree reconstruction artifacts, e.g. (I) the bacterial rooting of the universal tree of life; (II) the early emergence of amitochondriate lineages in eukaryotic phylogenies; and (III) the position of hyperthermophilic taxa in bacterial phylogenies. We present an alternative view of this tree, based on recent evidence obtained from reanalyses of ancient data sets and from novel analyses of large combination of genes (Gribaldo & Philippe, 2002).

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Mitochondrial DNA (mtDNA) is DNA that is located in mitochondria. This is in contrast to most DNA of eukaryotic organisms, which is found in the nucleus. Nuclear and mtDNA are thought to be of separate evolutionary origin, with the mtDNA being derived from bacteria that were engulfed by early precursors of eukaryotic cells. Thus in cells in current organisms, the vast majority of proteins found in the mitochondria (~1500 in mammals) are encoded by nuclear DNA: some, if not most, are thought to have been originally of bacterial origin and have since been transferred to the nucleus during evolution. In mammals, 100% of the mtDNA contribution to a zygote is inherited from the mother and this is true for most, but not all, organisms. Currently, human mtDNA is present at 100-10,000 copies per cell, with each circular molecule consisting of 16,569 base pairs with 37 genes, 13 proteins (polypeptides), 22 transfer RNA (tRNAs) and two ribosomal RNAs (rRNAs).

Unlike nuclear DNA in which the genes are rearranged by ~50% each generation (due to the process called recombination), there is usually no change in mtDNA from parent to offspring by this mechanism. Because of this and the fact that its mutation rate is higher than nuclear DNA and easily measured, mtDNA is a powerful tool for tracking matrilineage, and has been used in this role for tracking many species back hundreds of generations. Human mtDNA can also be used to identify individuals, however it is not a failsafe way to discriminate involvement of people at crime scenes and is no longer commonly used in court cases for this purpose.

The primary cause of evolution is the mutational change of genes. A mutant gene or DNA sequence caused by nucleotide substitution, insertion/deletions, recombination, gene conversion and so forth may spread through the population by genetic drift and/or natural selection (Nei, 1986; Hartl & Clark, 1997) and eventually be fixed in a species. If this mutant gene produces a new morphological or physiological character, this character will be inherited by all the descendant species unless the gene mutates again. Therefore, if we establish a valid phylogenetic tree for a group of species, we are able to identify the lineage of species in which any specific character appeared mutation.

This information is useful in understanding the mechanism of evolution of any specific character of interest. Comparison of the environmental conditions of this lineage of species with those of species lacking the character may suggest whether the character evolved by a particular process of natural selection or by genetic drift. If we can identify the genes involved and study their evolutionary change, we will know what kind of mutational change has generated the particular morphological or physiological character (Nei & Kumar, 2000)

Materials and methods

The experimental material was represented by 20 individuals of *Carassius gibelio* Bloch, 1782 from two different populations – Movileni and Iasi (Iasi County). The sampling process followed to obtain approximately 3 cm long tissue samples from the dorsal muscle. The samples were kept in absolute ethanol at 4^oC. Also, for comparison, we used sequences taken from the GenBank, for species (*Carassius carassius* Ref. nr. AY714387 and *Carassius cuvieri* Ref. nr. AB045144), subspecies (*Carassius auratus langsdörfi* Ref. nr. AB006953) and hybrids (*Carassius auratus x Cyprinus carpio* Ref. nr. AY694420 and *Carassius auratus x Cyprinus carpio x Carassius cuvieri* Ref. nr. AY771781) of *Carassius* genera.

All samples were used for mitochondrial DNA extraction and purification using a method purposed by Ausubel in 1992, with phenol: chloroform : izoamyl alcohol (25 : 24 : 1) (Figure 1).

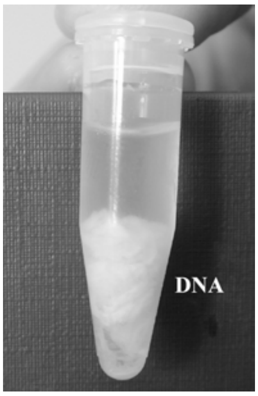

Fig. 1 - Precipitated DNA

The purified DNA samples were used like matrix for D-loop amplification and sequencing.

The D-loop amplification was made using a polymerize chain reaction (PCR) using two complementary primers (one for each DNA chain – direct and reverse) (Figure 2).

CTRL A 5`-TTCCACCTCTAACTCCCAAAGCTAG-3`

CTRL E 5`-CCTGAAGTAGGAACCAGATG-3`

Fig. 2 - The structure of mitochondrial control region amplification primers for the analyzed cyprinids

From the both primers we used 1,5µl with 2µM concentration. The aligning temperature for both primers was: 60^oC (Figure 3) with 30 replication cycles.

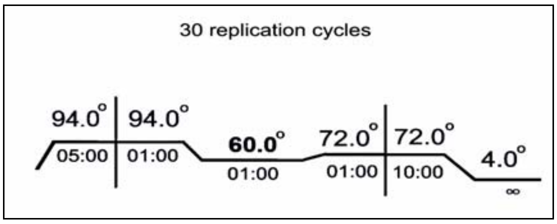

Fig. 3 - General PCR diagram, with the aligning temperature for ND4L gene, from *Carassius gibelio* Bloch., species

The product was tested in electrophoresis – product migration in an agarose gel 1,5%, with a volume of 30ml. For the establishment of cloning segment size a 100 base pairs weight molecular marker was used Figure 4.

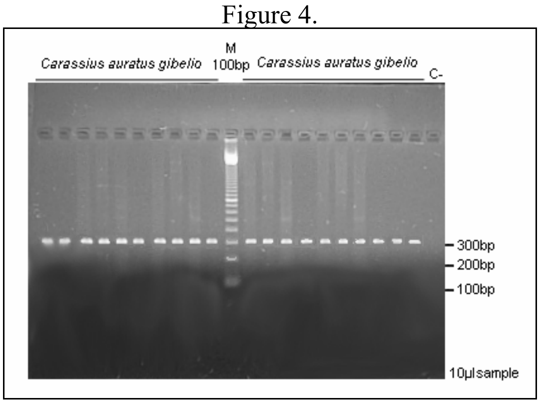

Fig. 4 - Electrophoresis in 1,5% agarose gel. 10µl samples.

From Figure 4 we can observe that the lengthiness of PCR cloned fragment is about 300 base pairs.

The PCR product purification was made using QIAGEN columns, a reaction kit and a protocol provided by the same mark.

Product quantification was made by gel migration in a 3% agarose gel, with 30ml volume and ØX174 – *Hinf I* molecular marker.

The sequencing reaction was made using a BECKMAN COULTER reaction kit and the same primers (CTRL-A and CTRL-E but with higher concentrations). The aligning temperature was 50°C (Figure 5) with 30 replication cycles.

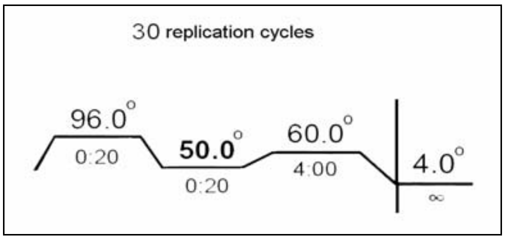

Fig. 5 - General sequence reaction diagram, with the aligning temperature

Fluorograms corresponding to nucleotide sequences were obtained with a CEQ 2000 BECKMAN COULTER sequence analyzer. The sequences correction and interpretation was done using CEQ2000 software.

The sequences were aligned using the Clustal V method (Higgins and Sharp, 1989) and verified by Clustal W (Thompson, 1994), obtaining in both cases the same result.

The phylogenetic trees were generated using MEGA 2 software.

Base on the obtained sequences, to estimate the number of nucleotide substitutions, it was necessary to use a mathematical model of nucleotide substitution. For this reason, many authors have developed different substitution models. Some of the models are presented in the form of substitution rate matrix in Table 1.

Tab. 1 - Models of nucleotide substitution (Nei & Kumar, 2000)

	A	T	C	G	A	T	C	G
	Jukes – Cantor model				HKY model			
A	-	α	α	α	-	βg_T	βg_C	αg_G
T	α	-	α	α	βg_A	-	αg_C	βg_G
C	α	α	-	α	βg_A	αg_T	-	βg_G
G	α	α	α	-	αg_A	βg_T	βg_C	-
	Kimura model				Tamura – Nei model			
A	-	β	β	α	-	βg_T	βg_C	$\alpha_1 g_G$
T	β	-	α	β	βg_A	-	$\alpha_2 g_C$	βg_G
C	β	α	-	β	βg_A	$\alpha_2 g_T$	-	βg_G
G	α	β	β	-	$\alpha_1 gA$	βg_T	βg_C	-
	Equal – input model				General reversible model			
A	-	αg_T	αg_C	αg_G	-	$a g_T$	$b g_C$	$c g_G$
T	αg_A	-	αg_C	αg_G	$a g_A$	-	$d g_C$	$e g_G$
C	αg_A	αg_T	-	αg_G	$b g_A$	$d g_T$	-	$f g_G$
G	αg_A	αg_T	αg_C	-	$c g_A$	$e g_T$	$f g_C$	-
	Tamura model				Unrestricted model			
A	-	$\beta\theta_2$	$\beta\theta_1$	$\alpha\theta_1$	-	a_{12}	a_{13}	a_{14}
T	$\beta\theta_2$	-	$\alpha\theta_1$	$\beta\theta_1$	a_{21}	-	a_{23}	a_{24}
C	$\beta\theta_2$	$\alpha\theta_2$	-	$\beta\theta_1$	a_{31}	a_{32}	-	a_{34}
G	$\alpha\theta_2$	$\beta\theta_2$	$\beta\theta_1$	-	a_{41}	a_{42}	a_{43}	-

Note: an element (e_{ij}) of the above substitution matrices stands for the substitution rate from the nucleotide in the i-th row to the nucleotide in the j-th column. g_A, g_T, g_C and g_G are the nucleotides frequencies. $\theta_1 = g_G + g_C$; $\theta_2 = g_A + g_T$.

All methods which are based on the Minimum Evolution (ME) method has nice statistical properties, it requires a substantial amount of computer time when the number of taxa compared is large. Saitou and Nei (1987) developed an efficient tree building method that is based on the ME principle. This method does not examine all possible topologies, but at each stage of taxon clustering a minimum evolution principle is used. This method is called the neighbor joining (NJ) method and is regarded as a simplified version of the

ME method. When four or five taxa are used, the NJ and ME methods give identical results (Saitou & Nei, 1987).

One of the important concepts in the NJ method is "neighbors" which are defined as two taxa that are connected by a single node in an unrooted tree. For example taxa 1 and 2 in the tree of Figure 6 are neighbors, because they are connected by only one node – A. Similarly, taxa 5 and 6 are neighbors, but all other pairs of taxa are not. However, if we combine taxa 1 and 2 and regard them as a single taxon, the combined taxon (1-2) and three are now neighbors.

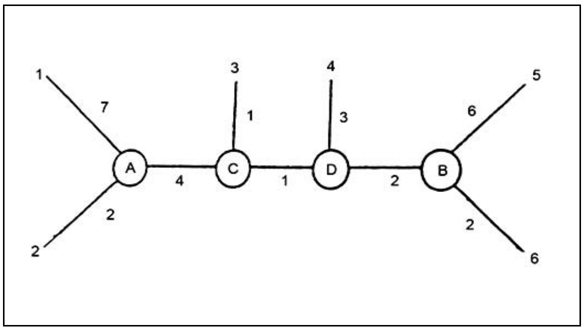

Fig. 6 - A phylogeny of six sequences with known branch lenghts

Construction of a tree by NJ method begins with a star tree, which is produced under the assumption that there is no clustering of taxa (Figure 7). If we estimate the branch lengths oof the star tree and compute the sum of all branches (S_0), this sum should be greater than the sum (S_F) for the true of the final NJ tree.

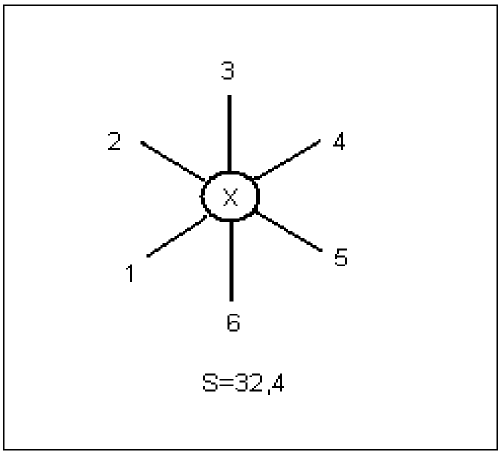

Fig. 7 - Star tree

However, if we pick up neighbors 1 and 2and consider the tree presented in Figure 8, the sum (S_{12}) of all branch lengths should be smaller than S_0, although it may be greater than S_F.

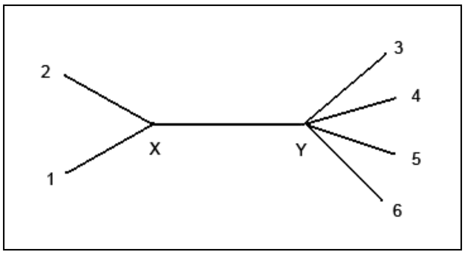

Fig. 8 - The first two neighbor taxons separation

In practice, since we do not know which pair of taxa are true neighbors, we consider all pairs of taxa as a potential pair of neighbors and compute the sum of branc lengths (S_{ij}) for the *i*-th and *j*-th taxa using a topology similar to that given in Figure 8. we can choose the taxa *i* and *j* that show the smallest S_{ij} value. Of course, actual distance values are subject to stochastic errors, so that the neighbors chosen in this way may not always be the true neighbors. Once a pair of neighbors is identified, they are combined into one composite taxon, and this procedure is repeated until the final tree is produced.

The next step is to compute the distance between the new node A and the remaining taxa (k; $3 \leq k \leq m$) (Figures 9 – 12)

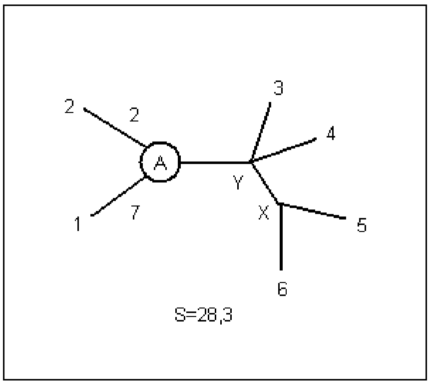

Fig. 9 - The A node separation by the rest of taxa

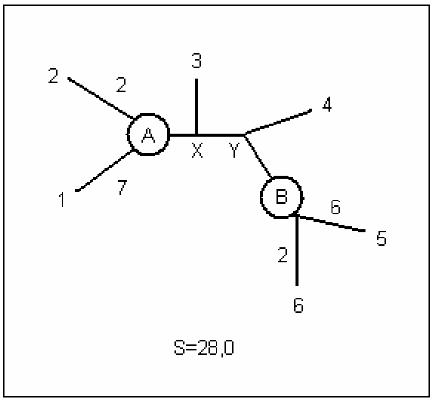

Fig. 10 - 5 and 6 taxas separation by B node forming, (Nei and Kumar, 2000)

To find the new pair of neighbors, we choose a pair with the smallest S_{ij} value. A new node B is then created for this pair of taxa. This procedure is repeated until all taxa are clustered in a single unrooted tree. The final tree obtained in this way is the NJ tree (Figure 12). Both the topology and the branch lengths of this tree are identical with those of the true tree from Figure 6.

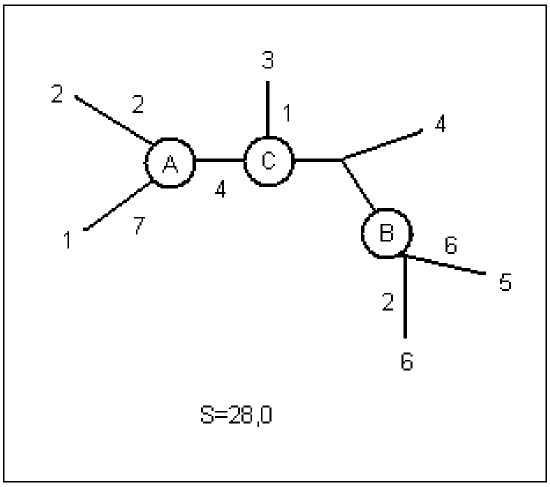

Fig. 11 - The third taxa by C node apparition, (Nei and Kumar, 2000)

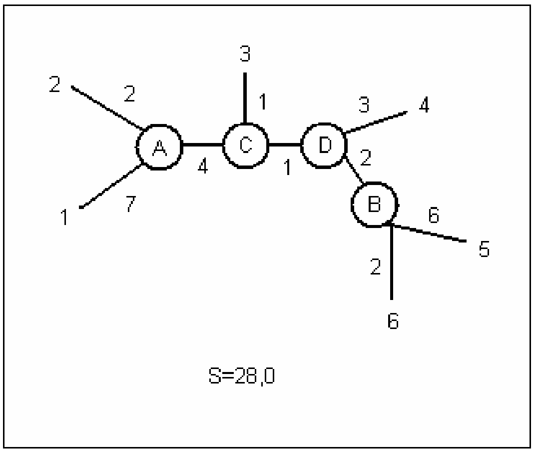

Fig. 12 - The 4 taxa separation by D node appearance, (Nei şi Kumar, 2000)

Results and discussions

Based on the proposed model and using the d-loop's molecular marker sequences obtained for the analyzed haplotypes and haplogroups we searched for the optimal NJ trees topology.

Analyzing the Figures 13 and 14, it is obviously, that different trees types, provides the same result and the same topologies.

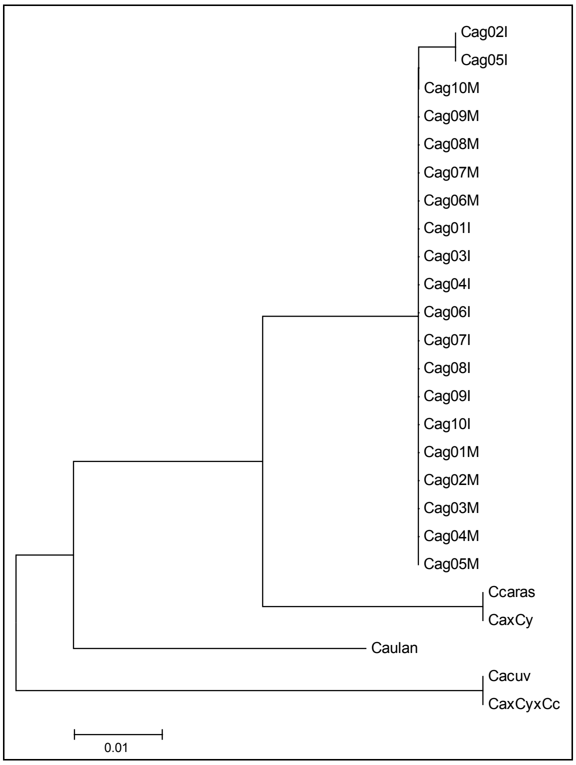

Fig. 13 - *Carassius* genera rectangular phylogenetic tree, base don the d-loop sequences

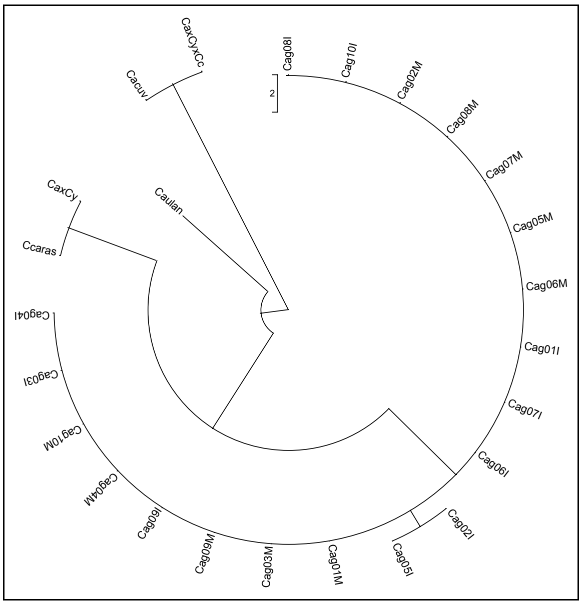

Fig. 14 - *Carassius* genera circular phylogenetic tree, base don the d-loop sequences

The trees generated using all three methods, have an identical topology, showing the taxa's clustering in similarity categories as well as each group's evolutive level. Therefore, we observe that *Carassius auratus langsdörfii* Temminck & Schlegel, 1846 species has the same origin as

Carassius cuvieri Temminck & Schlegel 1846, as well as the origin group for *Carassius carasssius* Linnaeus, 1758 and *Carassius gibelio* Bloch., 1782 species. We also noticed that the hybrids shared the same groups with the origin species.

Conclusions

From the obtained phylogenetic trees, we can conclude that the Neighbor –Joining method is very useful in studies which involve small number of taxa.

On the last evolution level the haplotype established for the two sequences is placed, followed by the general haplotype characteristic for the two populations.

The both trees show the monophyletic evolution of some species and subspecies of *Carassius* genera.

Rezumat

Modificările evolutive de la nivelul macromoleculelor de ADN sunt mai complicate decât cele din secvenţele proteice, deoarece există mai multe tipuri de ADN cum ar fi regiunile codificatoare, regiuni necodificatoare, exoni, introni, regiuni terminale, regiuni repetitive şi secvenţe de inserţie. Modificările produse de mutaţii la nivelul ADN; variază în funcţie de zona în care apar. Chiar dacă luăm în considerare o singură regiune codificatoare, modelul substituţiei nucleotidelor în prima, a doua şi a treia poziţie a unui codon, este diferit. Mai mult, unele regiuni sunt sub acţiunea selecţiei naturale, mai mult decât altele, acest fapt contribuind la variaţii ale modelului de evoluţie ale diferitelor regiuni ale ADN.

Scopul prezentei lucrări, este de a stabili un model experimental pentru observarea şi monitorizarea direcţiilor evolutive ale indivizilor genului *Carassius* din două populaţii Movileni şi Iaşi (Judeţul Iaşi).

References

1. AUSUBEL F. M., BRENT R., KINGSTON R. E., MOORE D. D., SEIDMAN J. G., SMITH J. A., STRUHL K., 1992 – *Short protocols in molecular biology*, 3-rd Edition, cap. 2 – *Preparation and analysis of DNA*. Ed. by John Wiley & Sons, Inc., 2-3 – 2-5.
2. GRIBALDO S., PHILIPPE H., 2002 – *Ancient phylogenetic relationships*, in *Theoretical population biology*, 61:4, 391 - 408.
3. HARTL D. L., CLARK A. G., 1997 – *Principles of population genetics*, Sinauer Associates, Sunderland, MA, 215 – 218.
4. HIGGINS D. G., SHARP P.M., 1989 – *Fast and sensitive multiple sequence alignments on a microcomputer.* CABIOS, 5:2 151-153.
5. KOONIN E. V., GALPERIN M. Y., 2002 – *Sequence, Evolution, Function*, Kluwer Academic Publisher, 1 - 10.
6. NEI M., 1986 – *Stochastic errors in DNA evolution and molecular phylogeny*, in *Evolutionary perspectives and the new genetics*, Ed. By H. Gershowitz, 167 – 181.
7. NEI M., KUMAR S., 2000 – *molecular evolution and phylogenetics*, Oxford University Press, 4 – 20, 103 – 107.
8. SAITOU N., NEI M., 1987 – *The neighbor-joining method: A new method for reconstructing phylogenetic trees*. Mol. Biol. Evol. 4:406 - 425.
9. THOMPSON J.D., 1994 – *Nucleic Acids Research*, 22: 4673 - 4680.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 401 – 410

A COMPARATIVE STUDY ON THE MORPHOLOGICAL CHARACTERISTICS AND BODILY COEFFICIENTS OF SOME CYPRINIDS SPECIES IN VARIOUS STAGES OF DEVELOPMENT

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ELENA CIORNEA*, ELENA RADA MISĂILĂ**

ABSTRACT

VASILE G., ION I., CIORNEA E., MISĂILĂ R. E., 2006 - A comparative study on the morphological characteristics and bodily coefficients of some cyprinids species in various stages of development. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 401-410.

The study develops a comparative analysis of some external bodily variables (total length, standard length, length of the head, maximum height of the body and circumference) in two cultured cyprinids species, bighead carp and silver carp, occurring in different stages of development in the accumulation of Ezăreni, district of Jassy.

At the same time, the possible correlations between the length of the head and the standard length of the body - on one side - and between circumference and the bodily weight - on the other - have been established. Finally, the values of the most representative indices and bodily coefficients of piscicultural growing, *i.e.*, the index of profile, the thickness index, Fulton index and the Kiselev coefficient, have been calculated from biometric determinations.

Key words: bighead carp, silver carp, biometry, correlation, bodily indices and coefficients

Introduction

The importance of the cyprinids imported from China lies in their turning to good account of the food reserves from piscicultural basins. Some of them, such as the soft and hard vegetation, not only can be used as food for the autochthonous fish but - more then that - deteriorate the existing living conditions to such an extent that they become wholly inappropriate - high cost operations being necessary for their combat (MANEA, 1985; GROZEA *et al*., 2002).

Introduction of plankton phages fish species assures higher productions, turns to complex account the otherwise unusable food reserves and hinders water's eutrophization. This last aspect - *i.e.*, water's eutrophization - grants a constant increase of its biological production, its transformation into fish meat occurring only in a 0.3% ratio, as most of it returns to either the primary consumers or directly into the circuit of the matter (GHITTINO, 1983; VASILE *et al*., 2005).

In several countries, in the combat against subnutrition, cyprinids represent the main source of cheap proteins, the products obtained from them containing essential aminoacids, usually absent in the protein substituents of vegetal nature (GIRAUD *et al*., 1996).

In recent years, the alimentary value of some Asian cyprinids species, such as the bighead carp and the silver carp, has been reconsidered, if considering their high content of polynonsaturated fatty acids (ω 3 and ω 6), their richness in this type of fatty acids being correlated, as well, with the lower temperatures of the water from their growing areas. The observation was made that the level of

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meat consumption is inversely proportional to the frequency of chronic, degenerative-type affections of the cardio-vascular apparatus, the value of the ω 3 / ω 6 fatty acid's ratio in the silver carp and bighead carp inducing positive effects, so that this type of fish meat is highly recommended as a *diet food in the prophylaxis and therapy of cardio-vascular maladies* (CSENGERI *et al.*, 1988; STEFFENS *et al.*, 1991; 1992).

Material and methods

The practical development of the present investigation involved experimental batches, each formed of 70 individuals of *Aristichthys nobilis* (bighead carp) and *Hypophthalmichthys molitrix* (silver carp) of various ages (An $_{1+}$, An $_{2+}$, An $_{3+}$ and, respectively, Hm $_{1+}$, Hm $_{2+}$, Hm $_{3+}$), all coming from the accumulation of Ezăreni, district of Jassy.

The main method applied for the analysis of external bodily variables under study (*i.e.*, total length, standard length, length of the head, maximum height of the body, circumference) was the biometric one (VOICAN *et al.*, 1974, 1975).

The results of the biometric determinations have been statistically processed, which permitted calculation of the average value, standard error, standard deviation, variance, variation coefficient of the average value and of the limits of confidence intervals, as well (VARVARA *et al.*, 2001).

Results and discussions

The values of the main statistical indices of the biometric parameters under study, for 1 year-old *Aristichthys nobilis* individuals, are listed in Tab. 1.

Tab. 1 - Values of the main statistical indices of An $_{1+}$

Variables / Statistical indices	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Mean	35.850	30.308	9.954	9.533	20.428	558.871
Standard error	0.259	0.265	0.131	0.070	0.132	12.257
Standard deviation	2.172	2.217	1.100	0.585	1.110	102.550
Variance	4.719	4.915	1.211	0.343	1.233	10516.693
CV%	6.060	7.315	11.057	6.146	5.437	18.349

L = total length of the body, ls = standard length, lc = length of the head,
H = maximum height of the body, Ci = circumference, G = weight

Table I shows that higher values of the main statistical indices (variance, standard deviation) have been recorded for total length, standard bodily length and bodily weight), while parameters such as: length of the head, height and circumference have a very low variability. The highest variation coefficient (18.34%) was recorded for the average bodily weight, while the average total length showed the lowest variation coefficient (6.06%).

Depending on the values of mean and standard deviation for the bodily variables considered, the (upper and lower) limits of the confidence intervals considered, within which the real mean of the population may be found, have been subsequently calculated on the basis of the critical value $t\ (\alpha, n\text{-}1)$, as given by $\alpha = 0.05$ and n-1 degrees of freedom, that is $t\ (0.05, 69) = 1.998$.

In this way, one may say, with a probability of 95% (α = 0.05), that the 1 year-old *Aristichthys nobilis* population from the Ezăreni accumulation has a total average length ranging between 35.33 - 36.36 cm, standard average length - between 29.77 -30.83 cm, average length of the head - between 9.69 - 10.21 cm, average height - between 9.39 - 9.67 cm, average circumference - between 20.16 - 20.69 cm, while average weight oscillates between 539.419 - 583.323 g (Fig. 1).

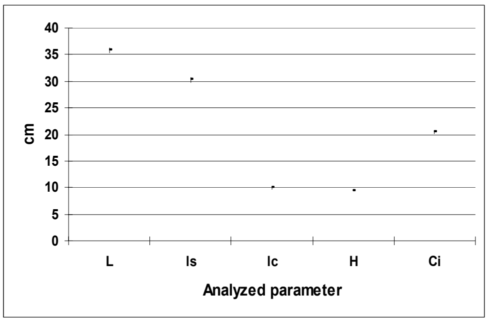

Fig.1 - Confidence intervals of the biometric parameters of An $_{1+}$

A subsequent stage in the analysis of the biometric data for the species under study involved the establishment of correlations between the manner in which - on one side - <u>the length of the head varies</u>

with the body's standard length and - on the other hand - the variation of circumference varies with bodily weight. To this end, the Pearson correlation index was calculated for each pair of characters under analysis, followed by testing of its significance. The *calculated t* values were compared with those of *the critical t* ones (α = 0.05, n-2) = 1.996, both the null (no correlation present) and the alternative (correlation present) hypothesis being thus established and on the basis of the comparison of *calculated t* with *critical t* value led to the acceptance one of the two hypotheses (VARVARA *et al.*, 2001).

In the 1 year-old bighead carp individuals, for both pairs of variables under study, the value of *calculated t* (of 10.899 and, respectively, 3.664) is higher than that of *critical t* (1.996), which means that the null hypothesis (according to which no correlation had been observed) is rejected, in favor of the alternative one.

As show by the graphical representation, as well (Figs. 2 - 3), the correlation between body's standard length and the length of the head is much more intense, *versus* the one manifested between body's circumference and weight.

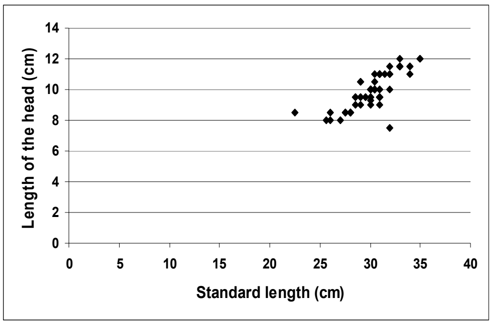

Fig. 2 - Correlation between standard length and length of the head in An $_{1+}$

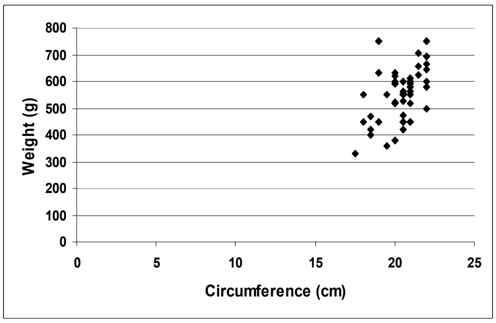

Fig.3 - Correlation between circumference and bodily weight in An $_{1+}$

In the 2 year-old *Aristichthys nobilis* representation, higher values of the both variance and standard deviation have been recorded for total length, standard length, circumference and bodily weight.

The highest values of the variation coefficient are recorded for the length of the head, followed by average weight, average standard length and average height of the body.

Similarly with the case of the 1 year-old individuals, the average total length registers the lowest variations coefficient (6.759%) (Tab. 2).

The graphical representation of the limits of confidence intervals of the biometric parameters under analysis evidences quite narrow values for all variables considered (Fig. 4).

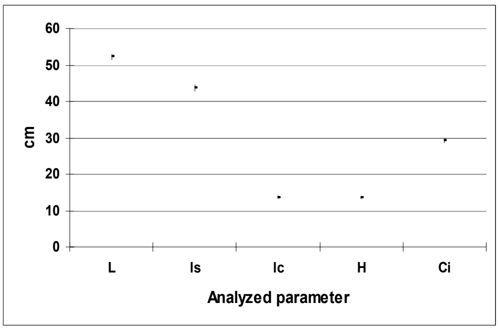

Fig. 4 - Confidence intervals of the biometric parameters of An $_{2+}$

Tab. 2 - Values of the main statistical indices of An $_{2+}$

Variables	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Statistical indices						
Mean	52.207	43.685	13.65	13.511	29.221	1700.714
Standard error	0.421	0.536	0.236	0.161	0.313	29.356
Standard deviation	3.528	4.485	1.975	1.354	2.623	245.612
Variance	12.452	20.117	3.901	1.833	6.881	60325.569
CV%	6.759	10.267	14.469	10.021	8.977	14.441

L = total length of the body, ls = standard length, lc = length of the head, H = maximum height of the body, Ci = circumference, G = weight

Thus, with a probability ratio of 95%, the 2 year-old individuals under study, belonging to the *Aristichthys nobilis* species, have an average total length of the body ranging between 51.36 - 53.04

cm, an average standard length between 42.61 - 44.75 cm, average length of the head between 13.17 - 14.12 cm, average of the height between 13.18 - 13.83 cm, average circumference between 28.59 - 29.84 cm, while the average bodily weight varies between 1642.15 - 1759.27 g.

Application of the statistical test for evaluating the significance of the correlation coefficient in the case of 2 year-old *Aristichthys nobilis* individuals between the two pairs of variables subjected to the study (*i.e.*, standard length - length of the head and, respectively, circumference-weight) led to the rejection of the null hypothesis and, consequently, to the acceptance of the alternative one as, in both cases, the value of *calculated t* (of 3.478 and, respectively, 5.720) was higher than that of *critical t* (1.996).

This time, the most intense correlation is to be recorded between circumference and bodily weight, unlike the situation recorded with 1 year-old individuals, when the strongest correlation was noticed between standard length and length of the head (Figs. 5 - 6).

As to the 3 year-old bighead carp representatives, the data listed in Table III show that, similarly with the case of the 2 year-old ones, total length, length of the head, circumference and weight record the highest values of variance, standard deviation and standard error of the mean.

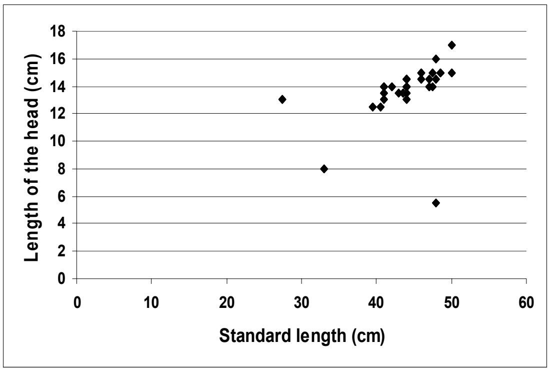

Fig.5 - Correlation between standard length and length of the head in An $_{2+}$

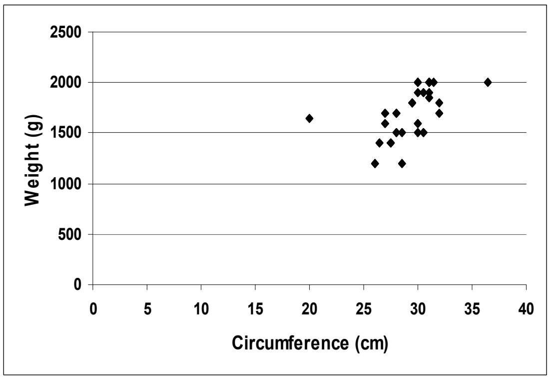

Fig.6 - Correlation between circumference and bodily weight in An $_{2+}$

Tab. 3 - Values of the main statistical indices of An $_{3+}$

Variables / Statistical indices	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Mean	64.485	56.285	18.2	20.242	40.842	3222.857
Standard error	0.953	0.779	0.292	0.283	0.674	65.058
Standard deviation	7.974	6.521	2.469	2.372	5.641	544.317
Variance	63.586	42.528	6.097	5.628	31.822	296281.573
CV%	12.365	11.585	13.567	11.719	13.811	16.889

L = total length of the body, ls = standard length, lc = length of the head,
H = maximum height of the body, Ci = circumference, G = weight

The total average length of the body varies between 62.58 - 66.38 cm, the standard average length - between 54.73 - 57.84 cm, the average length of the head - between 17.61 - 18.78 cm, average height - between 19.67 - 20.80 cm, average circumference between - 31.49 - 42.18 cm and average weight - between 3093.06 - 3352.64 g. As also evidenced in Figure 7, among all variables under analysis, the largest confidence interval is to be registered for bodily circumference.

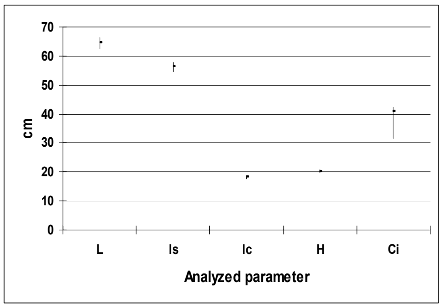

Fig.7 - Confidence intervals of the biometric parameters of An $_{3+}$

Analysis of the correlation observed led, once again, to the acceptance of the alternative hypothesis, which supports the existence of a correlation between the two pairs of variables under analysis (the *calculated t*, of 11.635 and, respectively, 11.225, is higher than the *critical t* value, of 1.996).

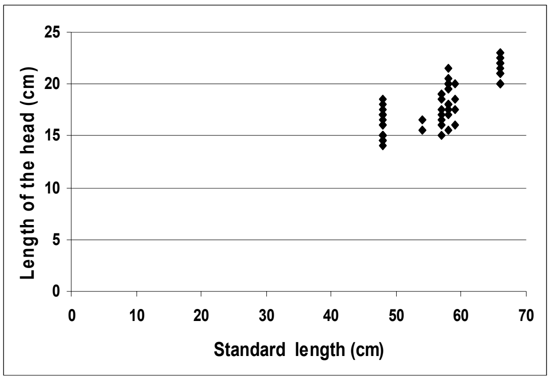

Fig.8 - Correlation between standard length and length of the head in An $_{3+}$

For a better understanding of the correlation noticed between the two pairs of variables under discussion, its graphical representation has been also plotted (Figs. 8 - 9). In this case, the correlation is equally strong between the tested variables, the value of *calculated t* being approximately equal for both pairs of variables considered.

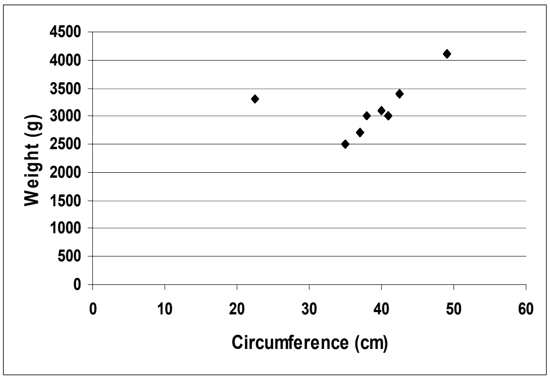

Fig.9 - Correlation between circumference and bodily weight in An $_{3+}$

Analysis of the main statistical indices of the 1 year-old *Hypophthalmichthys molitrix* representatives evidenced low values of mean's standard error, which indicates grouping of all parameters around the average value (Tab. 4).

The variation coefficient records its highest value for average bodily weight, the lowest one being observed for the total average length of the body.

One should also mention here the fact that a similar situation had been recorded with 1 year-old bighead carp, a case in which, nevertheless, the values of the variation coefficients had been lower than those of the silver carp population of the same age.

Tab. 4 - Values of the main statistical indices of Hm $_{1+}$

Variables / Statistical indices	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Mean	37.035	31.5	8.364	10.928	22.374	553
Standard error	0.371	0.328	0.045	0.140	0.276	14.810
Standard deviation	3.104	2.745	0.379	1.174	2.316	123.913
Variance	9.640	7.536	0.144	1.378	5.365	15354.637
CV%	8.383	8.714	4.542	10.744	10.352	22.407

L = total length of the body, ls = standard length, lc = length of the head,
H = maximum height of the body, Ci = circumference, G = weight

The graphical representation of the confidence intervals shows low limits of all biometric parameters considered for the study, which means certain uniformity among the 1 year-old *Hypophthalmichthys molitrix* representatives (Fig. 10).

Testing of the correlations coefficient for both pairs of variables led to the rejection of the null hypothesis and, consequently, acceptance of the alternative one. One may therefore assert the existence of correlations both between standard length and length of the head, and between circumference and bodily weight (*calculated t > critical t*).

The strongest correlation is registered between circumference and bodily weight, a different situation from that of the 1 year-old bighead carp, a case in which the most intense correlation appeared between standard length and length of the head (Figs. 11 - 12).

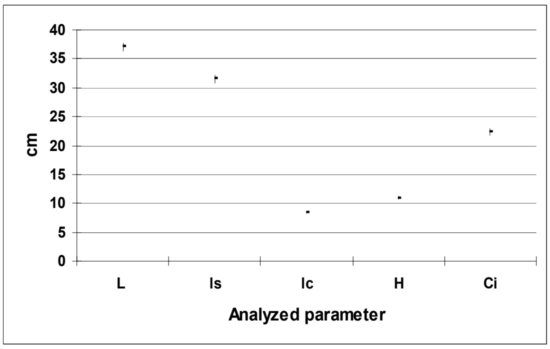

Fig.10 - Confidence intervals of the biometric parameters of Hm $_{1+}$

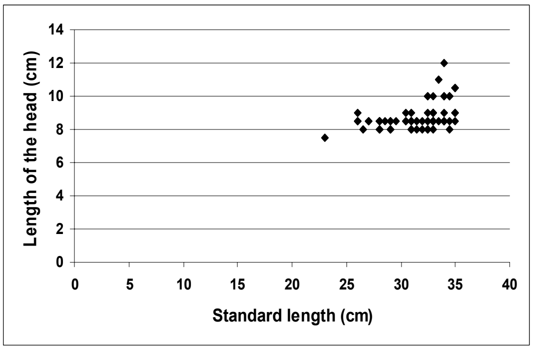

Fig.11 - Correlation between standard length and length of the head in Hm $_{1+}$

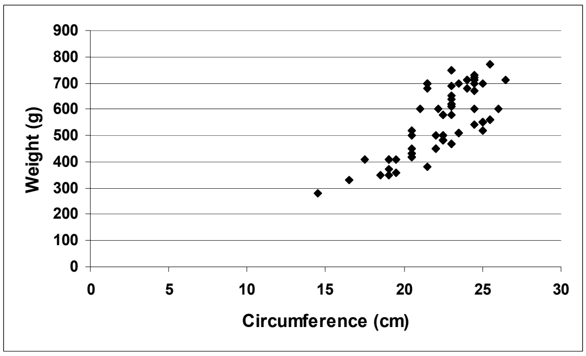

Fig.12 - Correlation between circumference and bodily weight in Hm $_{1+}$

Among the 2 year-old representatives of the *Hypophthalmichthys molitrix* species, higher values of the both variance and standard deviation are recorded, as well as in the case of the also 2 year-old bighead carp from the same ecosystem, for total length, standard length, circumference and bodily weight.

The lowest variation coefficient was found for average standard length (7.80%), while, in the bighead carp of the same age, total average length registered the lowest variation coefficient (Tab 5).

Tab. 5 - Values of the main statistical indices of Hm $_{2+}$

Variables / Statistical indices	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Mean	55.208	47.95	11.978	15.851	32.692	1520
Standard error	0.521	0.447	0.148	0.192	0.335	46.172
Standard deviation	4.361	3.744	1.240	1.608	2.808	386.305
Variance	19.025	14.022	1.539	2.586	7.886	149231.884
CV%	7.900	7.809	10.357	10.146	8.589	25.414

L = total length of the body, ls = standard length, lc = length of the head, H = maximum height of the body, Ci = circumference, G = weight

Representation of the confidence intervals limits of the average value of the biometric parameters under study indicates, once again, uniformity among the *Hypophthalmichthys molitrix* individuals under analysis (Fig. 13).

With a 95% probability, one may assert that the 2 year-old silver carp individuals from the Ezăreni accumulation have an average total length of the body ranging between 54.16 - 56.24 cm, the standard average length - between 47.05 - 48.82 cm, the average length of the head - between 11.68 - 12.27 cm, average height - between 15.46 - 16.23 cm, while average circumference is between 32.02 - 33.36 cm and average weight 1427.88 - 1612.11 g.

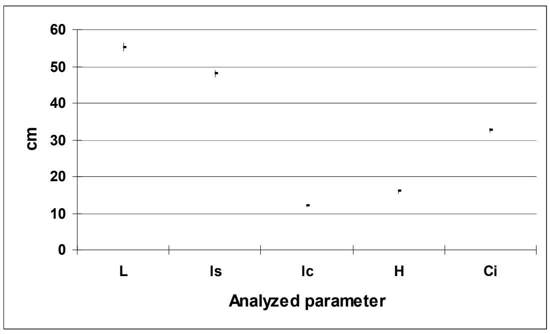

Fig.13 - Confidence intervals of the biometric parameters of Hm $_{2+}$

As to the significance of the index correlation between standard length and the length of the head, as well as between circumference and bodily weight, for both pairs of variables, the value of *calculated t* (of 2.563 and, respectively, 6.898) is higher than the value of *critical t* (1.996), which means rejection of the null hypothesis and acceptance of the alternative one, according to which correlations do exist between the variables under test.

Similarly with the case of the bighead carp of the same age, the most intense correlation is registered between circumference and bodily weight (Figs. 14 - 15).

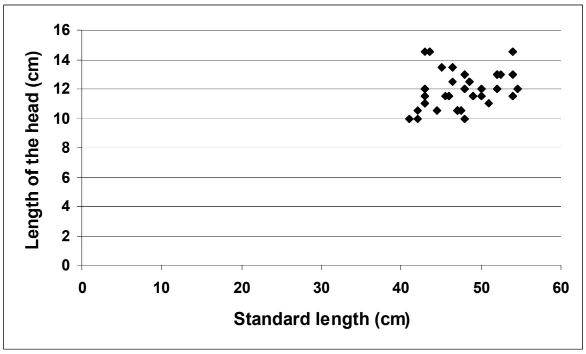

Fig.14 - Correlation between standard length and length of the head in Hm $_{2+}$

As to the variation coefficient of the mean value in the 3 year-old silver carp populations, this differs from the values recorded for the bighead carp of the same age, a case in which the highest variation coefficient appears for average weight, followed by the average length of the head, the lowest coefficient being recorded for the standard average length of the body.

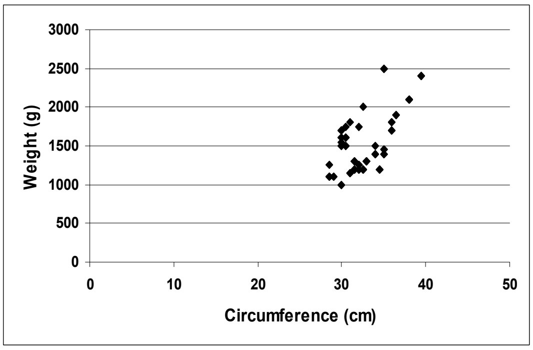

Fig.15 - Correlation between circumference and bodily weight in Hm $_{2+}$

Thus, in *Hypophthalmichthys molitrix*, the highest variation coefficient is registered for the average standard length of the body (18.70%), followed by average circumference (18.45%), its lowest value occurring in the case of bodily average weight (9.61%) (Tab.6).

Tab. 6 - Values of the main statistical indices of Hm $_{3+}$

Variables / Statistical indices	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Mean	62.471	54.078	13.821	18.342	37.428	3020.71
Standard error	1.329	1.209	0.178	0.268	0.825	34.720
Standard deviation	11.120	10.116	1.491	2.249	6.906	290.488
Variance	123.673	102.345	2.224	5.061	47.704	84383.54
CV%	17.801	18.707	10.792	12.265	18.453	9.616

L = total length of the body, ls = standard length, lc = length of the head,
H = maximum height of the body, Ci = circumference, G = weight

The total average length of the body varies between 59.81 - 65.12 cm, standard average length - between 51.66 - 56.49 cm, average length of the head - between 13.46 - 14.17 cm, average height - between 17.80 - 18.87 cm, average circumference - between 35.78 - 39.07 cm, while weight oscillates between 2951.44 - 3089.97 g.

Figure 16 shows that the 3 year-old silver carp representatives are homogeneous, the limits of the confidence intervals of all biometric parameters under study being extremely low.

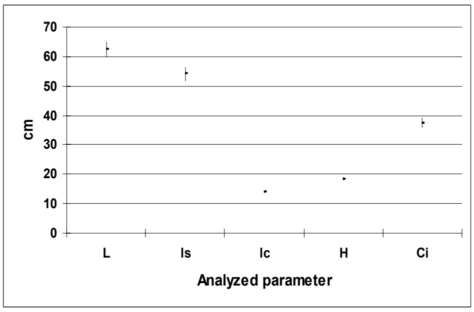

Fig.16 - Confidence intervals of the biometric parameters of Hm $_{3+}$

Analysis of the correlation between standard length and the length of the head explains the acceptance of the alternative hypothesis, this time again the value of *calculated t* (3.124) being higher than that of *critical t* (1.996).

Comparatively with the bighead carp of the same age, a case in which the correlation is almost equally intense for both pairs of variables under study, significant differences are to be observed in the case of silver carp, more exactly almost no correlation may be observed between the circumference and weight of the body (Figs. 17 - 18).

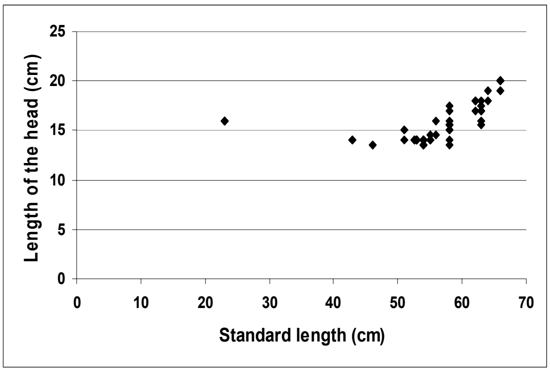

Fig.17 - Correlation between standard length and length of the head in Hm $_{3+}$

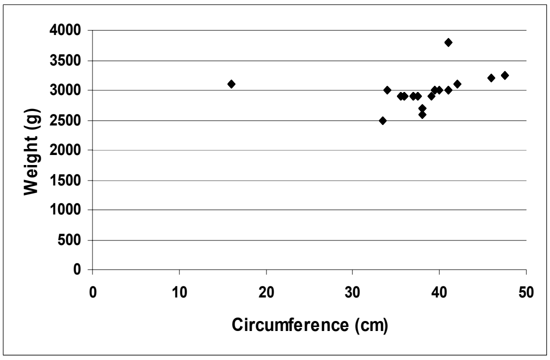

Fig.18 - Correlation between circumference and bodily weight in Hm $_{3+}$

On the basis of the data provided by biometric determinations and weighing, the average values of some bodily indices and coefficient (such as the profile, thickness and Kiselev index, and the Fulton coefficient) could be calculated, which permitted to characterize the whole population taken into study. Thus, the above-mentioned indices were calculated for both species, for a subsequent comparative study evidencing the possible differences or similarities between the *Aristichthys nobilis* and *Hypophthalmichthys molitrix* populations.

In the 1 year-old individuals, the average values of the profile index, of the Fulton coefficient, Kiselev and thickness index are enough close, which is indicative of a phenotypical similarity among the individuals of the two genera. Consequently, in *Aristichthys nobilis*, the profile index is of 3.179 while, in *Hypophthalmichthys molitrix*, it is of 2.882, these values supporting the idea of a possible morphological similarity among the individuals of the two species. As to the Fulton coefficient, the difference is quite low (of 0.238), the bighead carp appearing better developed than the silver carp, which is also evidenced by the index of thickness. Among of the bodily indices calculated, the lowest difference is recorded for the Kiselev index (0.075).

For an as eloquent as possible illustration of the similarity noticed between the two populations under analysis, the average value of the bodily indices has been plotted graphically (Fig. 19).

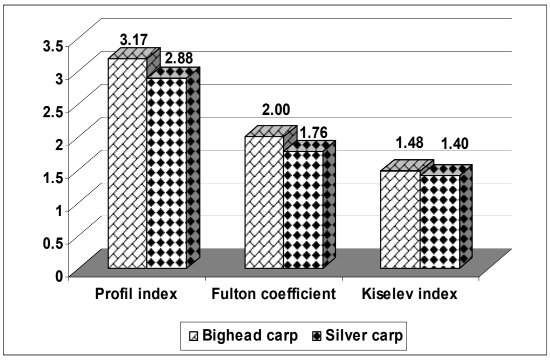

Fig.19 - Comparative representation of bodily indices of An $_{1+}$ and Hm $_{1+}$

In the 2 year-old individuals of *Aristichthys nobilis* and *Hypophthalmichthys molitrix*, the values of the bodily indices under analysis are extremely narrow, with the exception of the Fulton coefficient, a case in which the difference recorded between the two species is significantly higher (0.661), in favor of the *Aristichthys nobilis*, showing a more harmonious development *versus* that of the *Hypophthalmichthys molitrix* (Fig. 20).

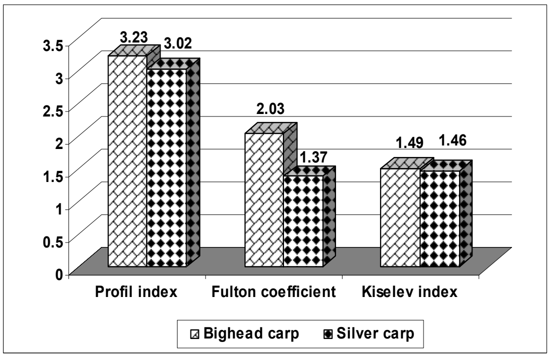

Fig.20 - Comparative representation of bodily indices of An $_{2+}$ and Hm $_{2+}$

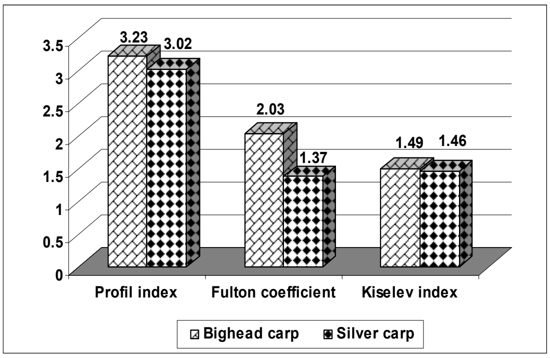

Fig.20 - Comparative representation of bodily indices of An $_{2+}$ and Hm $_{2+}$

A comparative analysis of the average values of the bodily indices in both 3 year-old *Aristichthys nobilis* and *Hypophthalmichthys molitrix* representatives shows that the differences observed between the two species are extremely low, a sign of a phenotypical similarity preserved along the whole evolution stage. However, in this case, some differences should be noticed, *i.e.*, all bodily indices analyzed record higher values in *Hypophthalmichthys molitrix*, which might suggest a more powerful development of the individuals belonging to this species in later stages of their evolution (Figs. 21 - 22).

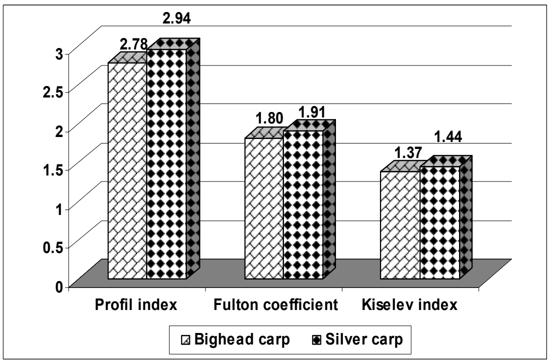

Fig.21 - Comparative representation of bodily indices of An $_{3+}$ and Hm $_{3+}$

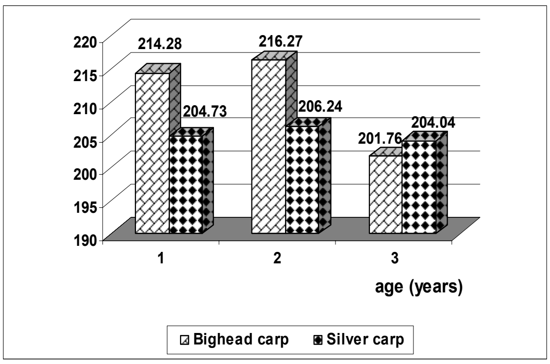

Fig.22 - Comparative representation of thickness index of bighead carp and silver carp

To better evidence the values of the bodily indices along the three stages of development taken into study, a graphical representation was performed, on groups of age, for each species.

Analysis of the values of bodily indices in *Aristichthys nobilis* populations evidenced significant differences from one year of growth to another. Thus, the maximum value of the parameters considered is recorded at an age of 2 years, which might suggest that the most pregnant development occurs within this period (Fig. 23).

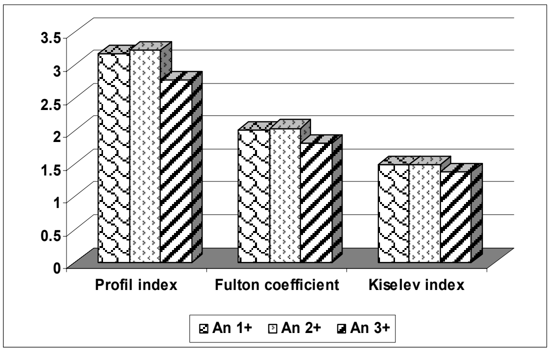

Fig.23 - Comparative representation of bodily indices of *Aristichthys nobilis*

In *Hypophthalmichthys molitrix*, as well, considerable differences appear among the bodily indices studied over a 3 year development period. If the profile index and the Kiselev index attain maximum values in the 2nd year of development, the Fulton coefficient shows a different evolution, namely, in this period, its minimum value is recorded (1.378), the maximum one being attained at the age of 3 years (1.910) (Fig. 24).

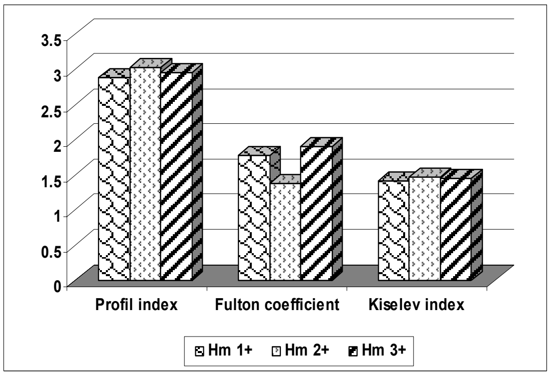

Fig.24 - Comparative representation of bodily indices of *Hypophthalmichthys molitrix*

Conclusions

The comparative study of the morphological characters, along with that of some bodily indices and coefficients, in *Aristichthys nobilis* and *Hypophthalmichthys molitrix* populations, over different stages of their development, led to the following general conclusions:

1. The confidence intervals of the average values for all bodily variables under analysis are extremely narrow in both species, the bodily circumference recording somehow larger limits (between 31.49 - 42.18 cm) in 3 year-old representatives.
2. In *Aristichthys nobilis*, study of the correlation indices for the two pairs of variables investigated (standard length - length of the head and, respectively, circumference - bodily weight) evidenced the presence of some positive correlations along the three evolution periods taken into study.
3. In the 1 year-old bighead carp, the most intense correlation is recorded between standard length and length of the head, in the 2 year-old one - between circumference and bodily weight while, in the 3 year-old one, the correlation evidences approximately equal values for both pairs of variables under analysis.
4. In *Hypophthalmichthys molitrix*, a close correlation is manifested between circumference and bodily weight in the first two years of life while, at a 3 year age, the most intense correlation appears between standard length and length of the head.
5. The average values of the bodily indices and coefficients are relatively close for both species under study, which indicates the existence of a phenotypical similarity among the individuals of the two genera.
6. Along the first two years of life, *Aristichthys nobilis* records higher average values of the bodily indices, comparatively with *Hypophthalmichthys molitrix*, although, at the age of 3 years, the situation is changed, which might suggest a more intense development of silver carp in latter stages of its evolution.
7. Unlike *Aristichthys nobilis*, the bodily indices of which follow the same curve in all three stages of development under study, in *Hypophthalmichthys molitrix*, the Fulton coefficient evidences a much lower value at the age of 2 years.

Rezumat

Lucrarea prezintă studiul comparativ al unor variabile corporale externe (lungimea totală, lungimea standard, lungimea capului, înălțimea maximă a corpului şi circumferința) la două specii de ciprinide de cultură, novac şi sânger, în diferite stadii de dezvoltare din acumularea Ezăreni, județul Iaşi.

De asemenea, s-au stabilit eventualele corelații pe de o parte între lungimea capului şi lungimea standard a corpului, iar pe de altă parte între circumferința şi greutatea corpului. În final, pe baza determinărilor biometrice au fost calculate valorile celor mai reprezentativi indici şi coeficienți corporali de întreținere piscicolă: indicele de profil, de grosime, Fulton şi coeficientul Kiselev.

References

1. CSENGERI I., MULLER F., OLAH J., MAJOROS F., FARKAS T., JOO I., TOTH S., GARAI I., HUSZKA T., 1988 - *Fish consumption and cardiovascular diseases*. In: Hungarian Conf. on Fisheries Sciences, Szarvas, 100 - 105.
2. GHITTINO P., 1983 - *Tecnologia e ittiopatologia in aquacoltura*. Vol I, Tecnologia, Ed. Bono Torino, 532 p.
3. GIRAUD J.P., SEVRIN - REYSSAC J., BILLARD R., 1996 - *La carpe argentée, Hypophthalmichthys molitrix*. La pisciculture française, Nr. 126, La Federation Francaise d' Aquaculture, 15 - 27.
4. GROZEA A., BURA M., 2002 - *Crapul: biologie, sisteme de creştere, patologie*. Ed. de Vest, Timişoara, 270 p.
5. MANEA I. GH., 1985 - *Aclimatizarea de noi peşti şi alte organisme acvatice*. Ed. Ceres, Bucureşti, 160 p.
6. STEFFENS W., WIRTH M., MIETH G., LIEDER U., 1991 - *Freshwater fish as a source of ω 3 polynesaturated fatty acids and their application to human nutrition*. Fish Nutrition in Practice, Biarritz (France), Nr. 61, Ed. INRA, Paris, 469 – 474.
7. STEFFENS V., LEIDER U., WIRTH M., MIETH G., 1992 - *Value of bighead and silver carp as a dietary food for prevention and therapy in cardiovascular disease*. Journal of Ichthyology, vol. 22, 143 - 146.
8. VARVARA M., ZAMFIRESCU Ş., NEACŞU P., 2001 - *Lucrări practice de ecologie*. Ed. Univ. „Al. I. Cuza” Iaşi, 152 p.
9. VASILE GABRIELA, MISĂILĂ, ELENA RADA, 2005 - *Date preliminare asupra creşterii ciprinidelor asiatice în Acumularea Ezăreni – Iaşi*. Lucrări ştiințifice, Seria Zootehnie, Vol. 48, U.S.A.M.V. Iaşi, Ed. Ion Ionescu de la Brad Iaşi, 649 - 654.
10. VOICAN V., RĂDULESCU I., LUSTUN L., 1974 - *Călăuza piscicultorului*. Ed. Ceres, Bucureşti, 366 p.
11. VOICAN V., LUSTUN L., RĂDULESCU I., 1975 - *Practica selecției şi reproducerii la peşti*. Ed. Ceres, Bucureşti, 192 p.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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ON THE ACTIVITY OF α-AMYLASE IN DIFFERENT SEGMENTS OF THE DIGESTIVE TUBE IN *ARISTICHTHHYS NOBILIS* AND *HYPOPHTHALMICHTHYS MOLITRIX*

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ABSTRACT

VASILE G., CIORNEA E., 2006 - On the activity of α-amylase in different segments of the digestive tube in *Aristichthhys nobilis* and *Hypophthalmichthys molitrix*.. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 411-415.

The paper discusses the results obtained in the analysis of α-amylase activity in various segments of the digestive tube (anterior, median and posterior), in two species of cultured cyprinids, namely *Aristichthys nobilis* (bighead carp) and *Hypophthalmichthys molitrix* (silver carp) from the accumulation of Ezăreni, the district of Jassy.

âThe data obtained showed that both between the species under investigation and, also, among the different segments of the digestive tube, no significant differences are to be noticed as to the activity of intestinal α-amylase.

Key words: α-amylase, digestive tube, *Aristichthys nobilis*, *Hypophthalmichthys molitrix*.

Introduction

The digestive tractus of fish contains a large spectrum of hydrolases, which facilitate scission of the various nutrients and integration of their decomposition products in the cellular and tissular metabolism. In various fish species, these enzymes are differentiated, first by the level of their catalytic activity (APETROAEI *et al*., 1980; ARTENIE *et al*., 1983; 1984).

The food entering the gastro-intestinal tractus is subjected to some complex biochemical transformations, realized by the specific enzymes of the digestive organs (VASILE *et al*., 2006 b). In the digestive tractus of cyprinids, there prevail the enzymes involved in polyglucides' hydrolysis, of which a special part is played by α-amylase (ARTENIE, 1990; ARTENIE *et al*., 1995; VASILE *et al*., 2006 a).

In the case of fish, α-amylases are present along the whole length of the digestive tractus, once known that the relative activity of such enzymes is closely correlated with the nature of the alimentary regime. In the predominantly herbaceous *Tylapia* genus, the activity of α-amylase is distributed along the whole length of the gastro-intestinal tract while, in the case of pearch (*Perca fluviatilis*), which is a carnivorous species, the pancreas is the only source of amylolytic activity (OPREA *et al*., 2000).

Material and methods

For the experiments, samples from the anterior, median and posterior region of the digestive tube have been taken over from 11, 4 year-old individuals of *Aristichthys nobilis* (bighead carp) and *Hypophthalmichthys molitrix* (silver carp) from the accumulation of Ezăreni, the district of Jassy. Mention should be made of the fact that no artificial food has been administered to the individuals under study, their feeding being based exclusively on the natural resources of their ecosystem.

The activity of α-amylase has been determined by the Métais-Bieth method, the results obtained being expressed as mg starch / ml x 30 min. (COJOCARU, 2005).

For each individual in part, the intestinal content has been removed through scraping, three parallel dosing operations being made each time, the data presented representing the average value of these repetitions; finally, the obtained results have been processed statistically (FOWLER *et al*., 2000).

Results and discussions

In *Aristichthys nobilis*, the α-amylase activity in the anterior intestine evidences no large variation limits. Thus, the minimum value of the enzymatic activity is of 2.172 mg starch / ml x 30 min., while the maximum one is of 2.876 mg starch / ml x 30 min.

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For better evidencing the amylasic activity, the obtained values have been graphically plotted, such representation showing the homogeneity of the obtained results (Fig. 1).

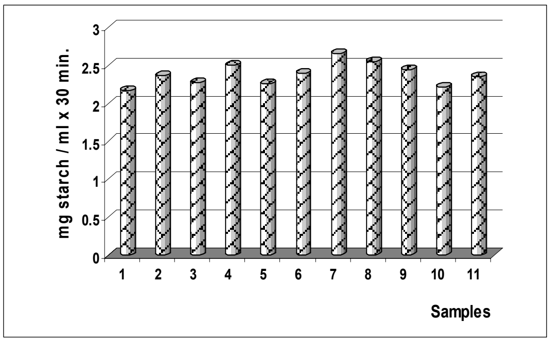

Fig.1 - Activity of α-amylase from the anterior intestine of *Aristichthys nobilis*

It is generally known that the nature of the food provided determines a certain differentiation among the digestive enzymes, that is, food's metabolization rate depends on its quality and composition. Consequently, the activity of α-amylase registers considerable increases when a higher amount of polyglucides is incorporated into the food (ARTENIE *et al*., 1983). That is why, special mention is here to be made of the fact that no additional food has been administered to the 11 individuals subjected to analysis.

On the basis of the average values and of standard deviation the (upper and lower) limits of the confidence intervals of α-amylase activity have been subsequently calculated as a function of a critical value $t\ (\alpha, n\text{-}1)$, given by $\alpha = 0.05$ (*i.e.,* a probability ratio of 95%), and *n* degrees of freedom (where *n* represents the number of values within each sample), that is $t\ (0.05, 10) = 2.228$.

As suggestively illustrated by the graphical representation, as well (Fig. 2), the confidence intervals of the enzymatic activity are, generally, quite narrow, large limits being however recorded for individuals 7 and 8 (2.234 - 3.178 mg starch / ml x 30 min. and, respectively, 2.175 - 2.930 mg starch / ml x 30 min).

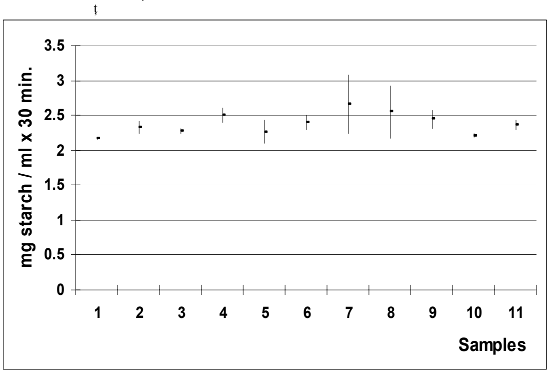

Fig.2 - Confidence intervals of α-amylase from the anterior intestine of *Aristichthys nobilis*

In the average intestine of the bighead carp individuals under investigation, the amylasic activity range between 2.155 - 2.826 mg starch / ml x 30 min., no inter-individual variations being recorded, as the obtained values were homogenous (Fig. 3).

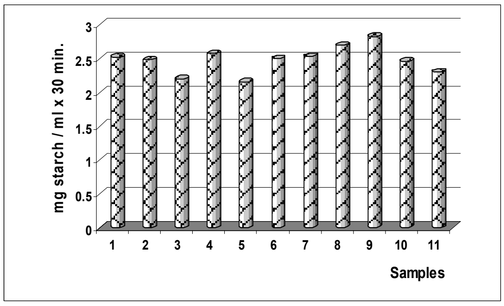

Fig.3 - Activity of α-amylase from the average intestine of *Aristichthys nobilis*

The limits of the confidence intervals of α-amylase activity are quite narrow, large intervals being evidenced for individuals 4 and 11 (2.335 - 2.789 mg starch / ml x 30 min. and, respectively, 1.918 - 2.684 mg starch / ml x 30 min.) (Fig. 4).

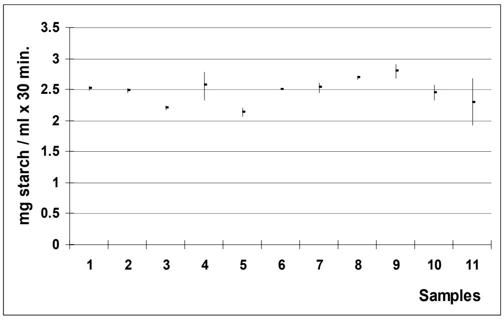

Fig.4 - Confidence intervals of α-amylase from the average intestine of *Aristichthys nobilis*

The activity of α-amylase from the posterior intestine of *Aristichthys nobilis* shows no larger variation limits from one individual to another, remaining within the range 2.157 - 2.703 mg starch / ml x 30 min. (Fig. 5).

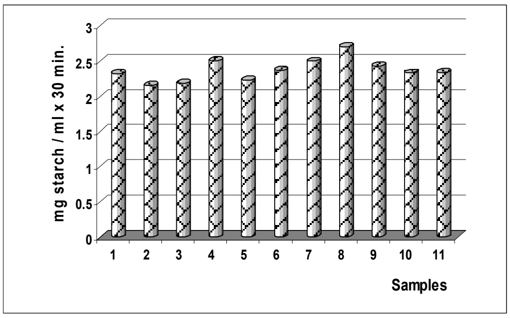

Fig.5 - Activity of α-amylase from the posterior intestine of *Aristichthys nobilis*

As to the limits of the confidence intervals of the amylasic activity from the posterior part of the digestive tube, they are extremely narrow from some of the individuals taken into study, while, in a series of four samples, somehow larger values are to be recorded (Fig. 6).

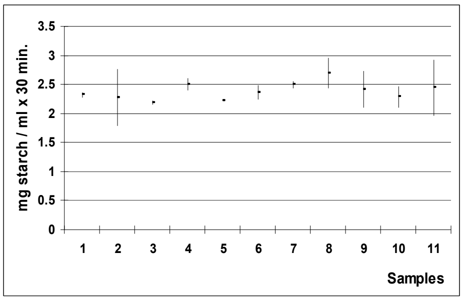

Fig.6 - Confidence intervals of α-amylase from the posterior intestine of *Aristichthys nobilis*

In the case of *Hypophthalmichthys molitrix*, the activity of α-amylase from the anterior intestine is relatively homogenous in all individuals analyzed, oscillating between 2.029 - 2.605 mg starch / ml x 30 min., which are values comparable to those recorded for bighead carp (Fig. 7).

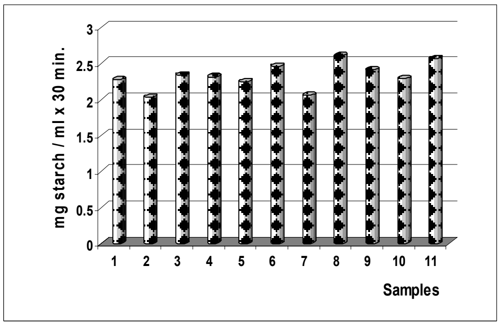

Fig.7 - Activity of α-amylase from the anterior intestine of *Hypophthalmichthys molitrix*

Also, the limits of the confidence intervals of enzymatic activity are narrow for the all samples under study, with the only exception of individual 4, whose interval is somehow larger (2.045 - 3.035 mg starch / ml x 30 min.) (Fig. 8).

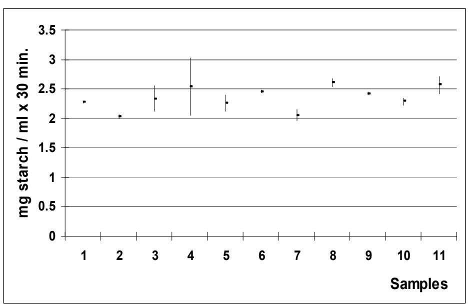

Fig.8 - Confidence intervals of α-amylase from the anterior intestine of *Hypophthalmichthys molitrix*

As to the enzymatic activity developed in the median portion of the digestive tube, the situation is changed, namely α-amylase shows quite intense inter-individual variations, the values it records ranging between 2.268 - 2.679 mg starch / ml x 30 min. (fig. 9).

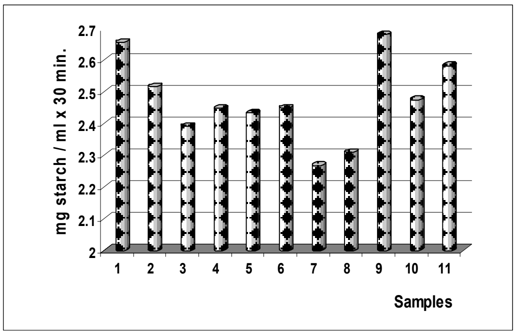

Fig.9 - Activity of α-amylase from the average intestine of *Hypophthalmichthys molitrix*

In this case, again, the limits of the confidence intervals are quite narrow for all individuals under investigation (Fig. 10).

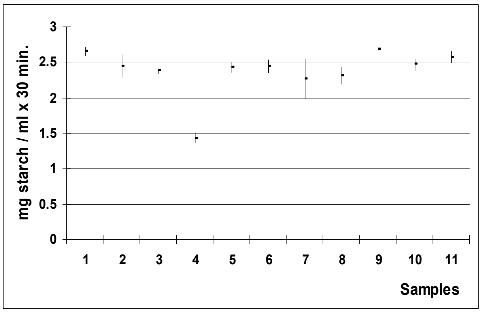

Fig.10 - Confidence intervals of α-amylase from the average intestine of *Hypophthalmichthys molitrix*

In the representatives of the silver carp, the activity of α-amylase from the posterior intestine oscillates over the 2.039 - 2.667 mg starch / ml x 30 min. interval. As show in the graphical representation, too, (Fig. 11), no variations from one individual to another are to be recorded.

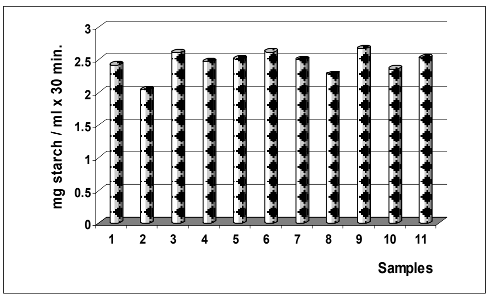

Fig.11 - Activity of α-amylase from the posterior intestine of *Hypophthalmichthys molitrix*

As to the limits of the confidence intervals, they are also narrow in all cases taken into study (Fig. 12).

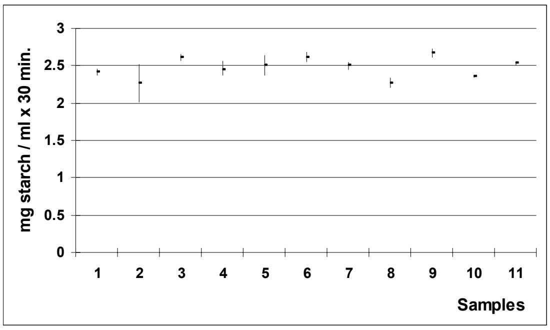

Fig.12 - Confidence intervals of α-amylase from the posterior intestine of *Hypophthalmichthys molitrix*

To check the possible differences or similarities in the α-amylase activity of the two species here considered, as well as among the different segments of the digestive tube, the **unifactorial pattern ANOVA test**, with an equal number of observations in the cell, has been applied, permitting calculation of the square sources, on the basis of the (external, internal and total) variability sources, the factor value, as well as of its critical value.

Application of the experimental results established the null (H_0 - no differences) and the alternative (H_1 - differences present) hypothesis of the test, while the comparison between the *calculated t* and *critical t* values led to a subsequent acceptance of one of the above-mentioned hypotheses (FOWLER *et al.*, 2000).

Therefore, in the case of both bighead carp and silver carp, no significant differences are to be recorded between the different portions of the digestive tube, the enzymatic activity following the same curve (Figs. 13 - 14).

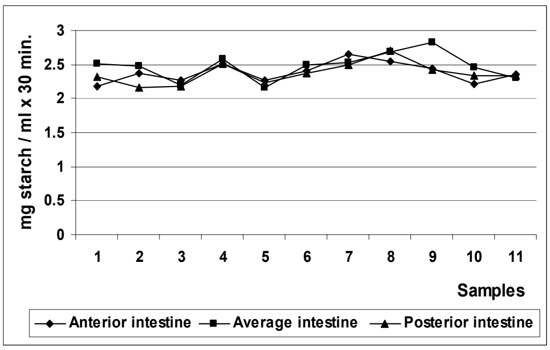

Fig.13 - Comparative representation of intestinal α-amylase activity in *Aristichthys nobilis*

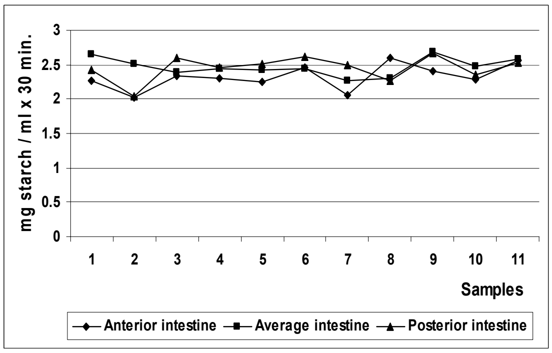

Fig.14 - Comparative representation of intestinal α-amylase activity in *Hypophthalmichthys molitrix*

As to the comparative representation of the enzymatic activity for the same segment of the digestive tube in each species in part, statistical analysis of the data obtained evidenced no considerable differences (Figs. 15 - 17).

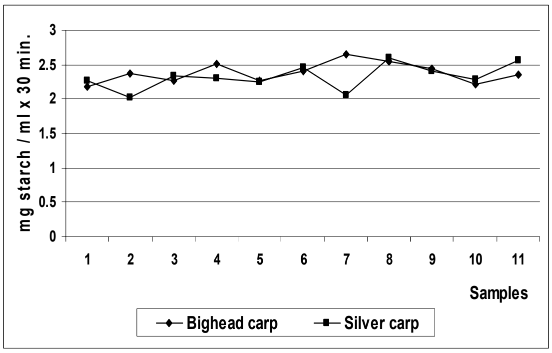

Fig.15 - Comparative representation of the α-amylase activity from the anterior intestine in bighead carp and silver carp

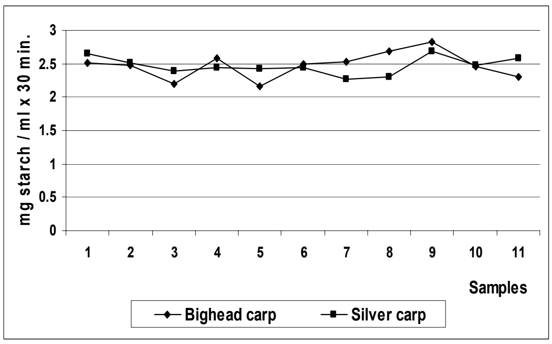

Fig.16 - Comparative representation of the α-amylase activity from the average intestine in bighead carp and silver carp

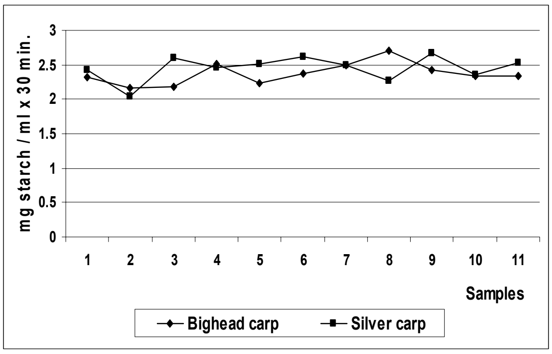

Fig.17 - Comparative representation of the α-amylase activity from the posterior intestine in bighead carp and silver carp

Conclusions

1. The activity of α-amylase in 4 year-old bighead carp and silver carp individuals generally records values ranging between 2.15 - 2.85 mg starch / ml x 30 min., no striking differences being observed in the three segments of the digestive tube.
2. In both species taken into study, *Aristichthys nobilis* and *Hypophthalmichthys molitrix*, the limits of the confidence intervals of the amylasic activity are quite narrow in all samples analyzed.
3. Statistical analysis of the data obtained on the activity of intestinal α-amylase in various segments of the digestive tube evidences no striking differences between the two species of cultured cyprinids.

Rezumat

Lucrarea prezintă rezultatele cercetărilor asupra activităţii α-amilazei în diferite segmente ale tubului digestiv (anterior, median şi posterior) la două specii de ciprinide de cultură şi anume, *Aristichthys nobilis* (novac) şi *Hypophthalmichthys molitrix* (sânger) provenite din acumularea Ezăreni, judeţul Iaşi.

Datele obţinute evidenţiază faptul că atât între speciile luate în studiu cât şi între diferite segmente ale tubului digestiv nu se constată diferenţe semnificative în ceea ce priveşte activitatea α-amilazei intestinale.

References

1. APETROAEI M., BATTES, K.W., 1980 - *Date privind activitatea unor enzime digestive la crapul de cultură (Cyprinus carpio L.) crescut în condiţii intensive, II. Activitatea alfa - amilazelor şi lipazelor*, Trav. Station „Stejarul”, Limnol., Vol. 8, 197 - 205.
2. ARTENIE VL., 1990 - *Activitatea enzimelor - indicator al transformărilor metabolice în creşterea intensivă a peştilor*, Lucrările S. C. P. Piscicolă - Iaşi, Vol. 1, 357 - 364.
3. ARTENIE VL., MISĂILĂ C., 1983 - *Activitatea unor enzime digestive la păstrăvul curcubeu (Salmo gairdneri Rich.), furajat cu hrană concentrată conţinând făină de alge*, St. Cerc. Biochim., Vol. 26, Nr. 2., 87 - 91.
4. ARTENIE VL., MISĂILĂ C., 1984 - *Bioritmul activităţii alfa-amilazei intestinale la păstrăvul curcubeu (Salmo gairdneri Rich.)*, St. Cerc. Biochim., Vol. 27, Nr.1, 16 - 19.
5. ARTENIE VL., MISĂILĂ E.-R., TĂNASE E., MISĂILĂ C., TOMA O., 1995 - *Activitatea unor enzime în organismul păstrăvului curcubeu (Oncorhynchus mykiss), crescut în condiţii intensive în ape colinare*, Acvacultura şi pescuitul, Vol. 1, Galaţi, 242 - 245.
6. COJOCARU D.C., 2005 - *Enzimologie practică*, Ed. Tehnopress, Iaşi, 466 p.
7. FOWLER J., COCHEN L., JARVIS P., 2000 - *Practical statistics for field biology*, Second Edition, Ed. by John Wiley & Sons, Ltd., England, 259 p.
8. OPREA L., GEORGESCU R., 2000 - *Nutriţia şi alimentaţia peştilor*, Ed. Tehnică, Bucureşti, 272 p.
9. VASILE G., CIORNEA E., COJOCARU D.C., 2006 a - *On the activity of α-amylase in some species of asian cyprinids*, An. Şt. Univ. „Alexandru Ioan Cuza” Iaşi, s. II a Genetică şi Biologie Moleculară, Tom VII, Fasc. 1, 75 - 78.
10. VASILE G., CIORNEA E., COJOCARU D.C., 2006 b - *A comparative study on the activity of alanin-aminotransferase in Hypophthalmichthys molitrix and Aristichthys nobilis*, An. Şt. Univ. „Alexandru Ioan Cuza” Iaşi, s. II a Genetică şi Biologie Moleculară, Tom VII, Fasc. 1, 79 - 82.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 416 – 422

FEEDING CHARACTERISTICS OF *TRITURUS CRISTATUS* SPECIES FROM POIANA TASAD REGION (ROMANIA)

ALFRED-STEFAN CICORT-LUCACIU*, RAMONA COVACI,
GABRIELA TOTH, ZITA FILEP, FLORENTINA BANDI**

ABSTRACT

CICORT-LUCACIU A.Şt, COVACI R., TOTH G., FILEP Z., BANDI F., 2006 - Feeding characteristics of *Triturus cristatus* species from Poiana Tasad region (Romania). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 416-422.

Among the studied newts there were no individuals with empty stomachs. In the stomach contents we identified minerals, vegetal remains and animal preys. The animal type food was represented by molted skin of its own species, amphibian eggs and 1822 prey items. The most important prey taxa are Nematocera larvae and brown ranids' tadpoles. Most of the preys were from the aquatic environment (93.46 %). The collecting period, newts' sex and age (size) as well as the habitat had strongly influenced the feeding aspects.

Key words: *Triturus cristatus*, feeding, sexes, size

Introduction

Food is the primary link between an animal and its environment (Kennett & Troy, 1996), and obtaining the food is the key factor of its ecology because it requires a long time from the animal's lifetime (Perry et al., 1990). Therefore, the study of feeding biology is necessary for understanding the ecology of much type of organisms (Hodar, 1997). The importance of the trophical spectrum's study of amphibians is more imposed because they being active at the boundary of aquatic and terrestrial ecosystems occupy important positions in food chains (Burton & Likens, 1975).

Until this decade in the Romanian specialty literature there were no data about the feeding of crested newts (Cogălniceanu & Andrei 1992, Andrei & Torok 1997). Afterwards, a series of articles appeared on this subject (Covaciu-Marcov 2001 a, b, 2002 a, b, c, d; Cicort-Lucaciu 2004, 2005 a, b, 2006), however there isn't any study that analyses the feeding depending both on season, sex and habitat. Therefore, we proposed to realize such a study upon some populations of *Triturus cristatus* from Poiana Tăşad. These populations have been previously studied in 2002 (Covaciu-Marcov, 2002b), but on a much smaller sample size and without analyzing the influence of sex and size on newts' feeding.

Materials and methods

We studied the stomach contents of 245 newts collected in the spring of the year 2005, twice in a month: 30 III (March), 13 IV (April), 27 IV, 11 V (May) and 25 V. The newts were captured using a dredge with metallic rectangular frame. Where the depth was bigger we used a net with circular metallic frame attached at the end of a long metallic rod. For obtaining the stomach contents the stomach flushing method was used (Legler & Sullivan, 1979; Leclerc & Curtois, 1993). This method allows studying feeding aspects without killing the animals so the newts were released after flushing. The stomach contents were placed in airtight test tubes and preserved with a 5% solution of formalin. The preys' identification was made using the specialty literature (Crişan & Mureşan, 1999; Crişan & Cupşa,

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Radu & Radu, Ionescu et al, 1971), not being necessary a detailed taxonomic list (Meschersçky, 1997).

The habitats from Poiana Tăşad, a locality placed in the zone of Tăşad Hills at an altitude of approximate 350 m, are represented by two large ponds situated at the outskirt of a forest. The first pond (pond no.1) is small having 12 m^2, the second one (pond no.2) is bigger reaching 20 m^2. Their depth is variable, exceeding one meter in the bigger pond. These ponds have rich aquatic vegetation, silt substratum so the water has high turbidity. They are not permanently, but due to their large proportions there are years when the water remains all of the year. The distance between the two ponds is approximately 100 m.

Analyzing the samples we took consideration of the following aspects: 1. the taxa affiliation of the preys, 2. the variation of the maximum and average number of preys / stomach, 3. the amount of prey items, 4. the frequency with which the prey taxa was consumed, 5. the origin of preys (aquatic or terrestrial). We had in view the variation of these aspects depending on the season, habitat, newts' sex and age.

Tab. 1 - The number of samples analyzed depending on the collecting period, newts' sex and age, habitat

NO. OF SAMPLES	30 III	13 IV	27 IV	11 V	25 V	♂	♀	Ad.	Juv.	Pond 1	Pond 2	∑
	69	51	55	43	27	119	120	239	6	65	180	245

Results and discussions

Among the studied newts there were no individuals with empty stomachs. Their absence indicates that there were optimal feeding conditions (Sas el al, 2004). For most of the amphibian species the absence of stomachs contents is caused by the low temperatures from the beginning of their active period (Aszalos et al 2005, Covaciu-Marcov et al 2002e, 2003a, Sas et al 2003). In this case, the missing of empty stomachs is probably due to the fact that we started the study at the end of March when the conditions were optimal for newts to feed.

In the stomach contents we distinguished mineral elements, vegetal remains, shad-skin fragments, amphibian eggs and different animal type preys distributed in 29 categories.

Amphibians swallow plant materials accidentally together with the followed prey (Whitaker et al, 1977), in the stomach contents of many species being identified vegetal remains (Covaciu-Marcov et al 2004, 2005 a, b, Ghiurcă & Zaharia 2005, Sas et al 2005 a). The highest amount of stomach with vegetal (63.6 %) is recorded in the middle of the aquatic period indicating that the feeding was then the most intense, the newts consuming plant materials together with the captured animal prey. The potential preys from vegetation and the very fast preys whose capturing suppose rapid movements from newts, encourage the accidental intake of plant materials. The richer aquatic vegetation of the pond no.2 has led to the higher amount of vegetal remains in the food of the newts captured from here.

In March took place the molting of newts because of the passing from the terrestrial to the aquatic environment and the spawning of the brown ranids. The presence of molted skins and amphibian eggs in the habitats as well as the scarcity of mobile preys had forced the newts to obtain food on an olfactory way. The feeding with shad-skin is considered a habit of amphibians for epidermal protein recycling (Weldon et al, 1993) being widely spread at different species (Guidali et al 1999, Sas et al 2005 b). Juveniles and males had consumed more molted skins than adults and females. In the case of juveniles this is probably on account of small body size which not allows them to eat the scarce preys available at the beginning of the aquatic period. The males can explore larger parts of the habitat as a consequence of the dorsal crest which increases their mobility. Comparing the habitats it can be observed that in the pond no.1 there were consumed more shad-skins and eggs than in pond no.2. The explanation might be the fact that the first habitat being smaller can provide higher temperatures for that period of the year, and on the other hand the fact that this pond houses a larger number of amphibians on the volume unit.

The evolution of eggs' consumption shows the evolution of their presence in the habitat. Eggs represent a food resource important quantitative being massively consumed whenever they are available by *Triturus cristatus* (Covaciu-Marcov et al 2002 a) as well as by other species of newts (Covaciu-Marcov et al 2003 b).

In the stomach contents we identified 1822 prey items belonging to the following categories: 1. Annelida-Oligochaeta, 2. aquatic Gastropoda, 3. terrestrial Gastropoda, 4. Lamellibranchiate, 5. Crustacea-Gammaridae, 6. Crustacea-Cladocera, 7. Crustacea-Isopoda, 8. Arachnida-Araneae, 9. Ephemeroptera larvae, 10. Odonata larvae, 11. Heteroptera, 12. Homoptera-Aphididae, 13. Homoptera-Cicadillidae, 14. Lepidoptera larvae, 15. Lepidoptera, 16. Trichoptera larvae, 17. Coleoptera-Dytiscidae larvae, 18. Coleoptera-Dytiscidae, 19. Coleoptera-Curculionidae, 20. Coleoptera-Scarabaeidae, 21. Coleoptera undetermined, 22.

Diptera-Nemetocera larvae, 23. Diptera-Nemetocera, 24. Diptera-Brachycera larvae, 25. Diptera-Brachycera, 26. Hymenoptera-Formicidae, 27. Anura larvae, 28. Urodela larvae, 29. Urodela.

The most important prey items for the crested newts, both by amount and frequency are Nematocera larvae and tadpoles. Cladocerans, although they have high amount, were less frequent consumed due to their small size and gregarious life style being distributed only in certain parts of the pond. The largest size among preys it belongs to the newt *Triturus vulgaris* and amphibians' larvae represented by **1.** *Salamandra salamandra* larvae and *Triturus vulgaris* larvae, **2.** larvae of its own species and **3.** tadpoles of *Rana dalmatina* and *Bufo Bufo*.

Preys diversity is probably continuously increasing in the habitats as advancing into the warm season but preys diversity was the highest at the third date of sample collection. This fact reveals that the studied newts are feeding the most intensively at the middle of aquatic period. The highest influence on preys' diversity has the newts' size. Juveniles have in the stomach contents four times less prey categories than adults. Habitats' size had also important influence on preys' diversity. The percentage of approximate 40% by which the preys' diversity of the newts from the second habitat is higher, complies with the habitats' ratio.

Tab. 2 - The frequency of stomachs with vegetal remains, shad-skin and amphibian eggs

	30 III	13 IV	27 IV	11 V	25 V	♂	♀	Ad.	Juv.	Pond 1	Pond 2	∑
VEGETAL	52,1	49,0	63,6	55,8	55,5	50,4	59,1	54,8	66,6	47,6	57,7	55,1
SHAD-SKIN	43,4	15,6	20,0	23,2	11,1	28,5	20,8	24,6	50,0	29,2	23,8	25,3
AMPH. EGGS	78,2	49,0	3,6	30,2	7,4	44,5	34,1	39,3	33,3	50,7	35,0	39,1

In March, the newts not being well accommodated with aquatic environment yet, had intensively foraged close by the ponds and terrestrial Gastropods had the highest amount and frequency after the Nematocera larvae. A first reason for this is that in March the number of available aquatic preys is little, shown also by the average number of preys / newt (1.06) which is small comparatively with the other months. A second reason is that Gastropods are slow and substantial preys.

In April, particularly at the end of this month, tadpoles have the highest amount and frequency after Nematocera larvae. The large size of tadpoles made the average number of preys / newt to be in this month (7.6) half as that in May (13.2). The fact that this difference is not because of the higher abundance of Cladocerans from May is shown by the maximum number which value in May do not exceed that from April.

In May, the highest amount after Nematocera larvae has Cladocerans and Lamellibranchians. However, Urodela larvae, Heteropterans and Dytiscidae larvae have higher frequency of consumption than Cladocerans and Lamellibranchians. The explication is given by the variations of amount and frequency values. As advancing into the warm season the number of individuals available for consumption from those three prey categories mentioned above increases. This numerical growth establishes a more homogeneous distribution of those preys in the habitats as concerning Cladocerans and Lamellibranchians. Cladocerans are grouped only in certain zones of the ponds and Lamellibranchians were captured only in the first habitat.

For both sexes the highest amount had Nematocera larvae and tadpoles, but there are some differences. At males, the largest amount after Nematocera larvae (67.6%) had Cladocerans (11.5%) and then tadpoles (8.3%). In the same time, males were bigger consumers of Nematocera larvae. The differences show different forage strategies females using more than males the „sit-and-wait" strategy. With this one the probability to capture tadpoles instead of Cladocerans is higher because tadpoles being faster and bigger swim further. Males use more the „active-foraging" strategy. Males are better swimmers due to dorsal and caudal crests and they move much more than females. Thus the probability to meet Nematocera larvae or to find a sector of pond with Cladocerans is highly increasing. For the same reasons as in the case of tadpoles, Urodela and Dytiscidae larvae have the amount twice bigger at females than males. The different forage strategies are also confirmed by the differences between the values of average number of preys / newt. The average number of preys at males (8.3) is higher than at females (6.0).

Tab. 3 - Number, amount and frequency of preys, the amount of aquatic and terrestrial preys depending on the collecting period, habitat, newts' sex and size

	30 III	13 IV	27 IV	11 V	25 V	♂	♀	Ad.	Juv.	Pond 1	Pond 2	∑
No. of preys, ***N***												
TOTAL NO.	73	441	368	607	333	995	730	1725	97	638	1184	1822
MAXIMUM NO.	9	41	27	39	42	42	41	42	39	41	42	42
AVERAGE NO.	1.0	8.6	6.6	14.1	12.3	8.3	6.0	7.21	16.1	9.8	6.5	7.43
Amount, ***P***												
OLIGOCHAETA	4.1	0	11.6	0	0	1.1	4.6	2.6	1.0	0.6	3.5	2.5
GASTR. TER.	10.9	0	5.7	1.6	0.3	1.2	3.8	2.3	0	6.1	0.08	2.1
LAMELLIBR.	0	0	0	2.3	5.1	1.2	1.2	1.2	10.3	4.8	0	1.7
CLADOCERA	0	0	0	17.6	8.1	11.5	2.6	7.7	0	3.7	9.2	7.3
ISOPODA	0	0	0.2	0	0.3	0	0.2	0.1	0	0	0.1	0.1
EPHEMEROP. L.	8.2	2.7	1.6	0.6	1.8	1.2	2.6	1.7	3.0	1.0	2.2	1.8
ODONATA L.	6.8	0.6	0.2	0.3	0.9	0.3	1.5	0.8	0	0.1	1.0	0.7
HETEROPTERA	1.3	0.4	0.2	1.4	4.2	1.5	1.6	1.5	0	0.1	2.1	1.4
APHIDIDAE	0	0	0	0	1.2	0.3	0.1	0.2	0	0	0.3	0.2
TRICHOP. L.	5.4	1.8	0.2	0	0	0.7	0.8	0.7	0	0.4	0.8	0.7
DYTISCIDAE L.	2.7	0	2.1	3.1	3.6	1.6	3.4	2.3	0	0.6	3.1	2.2
CURCULIONIDAE	2.7	0	0	0	0	0.2	0	0.1	0	0	0.1	0.1
COLEOPTERA UNDET.	1.3	0	1.8	0.8	0	0.5	1.0	0.7	0	0.1	1.0	0.7
NEMATOCERA L.	50.6	72.7	44.2	67.7	67.5	67.6	55.4	62.4	81.4	62.6	63.9	63.5
ANURA L.	0	21.3	27.9	1.1	0	8.3	16.3	11.7	2.0	18.0	7.5	11.2
URODELA L.	0	0	0	1.3	4.5	1.1	1.5	1.2	1.0	0	1.9	1.2
URODELA	2.7	0.2	1.3	0.4	0	0.3	1.0	0.6	0	0	0.9	0.6
OTHERS	3.2	0.2	24.8	1.7	2.4	1.3	2.3	2.1	0	1.8	2.3	1.5
Frequency, ***F***												
OLIGOCHAETA	4.3	0	34.5	0	0	5.8	11.6	8.7	16.6	4.6	10.5	8.9
GASTR. TER.	8.6	0	14.5	9.3	3.7	7.5	8.3	7.9	0	27.6	0.55	7.7
LAMELLIBR.	0	0	0	4.6	14.8	2.5	1.6	2.0	66.6	9.2	0	2.4
CLADOCERA	0	0	0	13.9	18.5	5.8	3.3	4.6	0	6.1	3.8	4.4
ISOPODA	0	0	18.1	0	3.7	0	1.6	0.8	0	0	1.1	4.4
EPHEMEROP. L.	5.7	15.6	9.0	4.6	11.1	7.5	10.0	8.7	33.3	7.6	9.4	8.9
ODONATA L.	7.2	5.8	1.8	4.6	11.1	2.5	9.1	5.8	0	1.5	7.2	5.7
HETEROPTERA	1.4	3.9	1.8	16.2	33.3	9.2	7.5	8.3	0	1.5	10.5	8.1
APHIDIDAE	0	0	0	0	7.4	0.8	0.8	0.8	0	0	1.1	0.8
TRICHOP. L.	5.7	7.8	1.8	0	0	3.3	4.1	3.7	0	4.6	3.3	3.6
DYTISCIDE L.	2.8	0	14.5	32.5	33.3	11.7	15.8	13.8	0	6.1	16.1	13.4
CURCUL.	1.4	0	0	0	0	0.8	0	0.4	0	0	0.5	0.4
COLEOP. NED	1.4	0	9.0	9.3	0	3.3	4.9	4.1	0	1.5	4.9	4.0
NEMATOCERA L.	13.0	84.3	65.4	88.3	88.8	61.3	59.1	60.2	100	66.1	59.4	61.2
ANURA L.	0	62.7	38.1	9.3	0	21.8	25.0	23.4	16.6	35.3	18.8	23.2
URODELA L.	0	0	0	13.9	37.0	5.8	6.6	6.2	16.6	0	8.8	6.5
URODELA	2.8	1.9	9.0	6.9	0	2.5	6.6	4.6	0	0	1.1	4.4
Percentage of terrestrial preys												
AMOUNT	19.17	0	16.55	3.78	2.70	4.42	10.0	6.78	2.06	7.21	6.16	6.53

Regarding the newts' age (size) it can be observed that Nematocera and Anura larvae have much higher values, both for amount and frequency, at adults than at juveniles. After Nematocera larvae the highest amount and frequency in the case of juveniles has Lamellibranchiates indicating that young newts take shelter at substratum level. The very high average number of preys / newt at juveniles (16.1) comparatively to adults (7.2) proves that juveniles cannot swallow large preys.

In the case of the first habitat, major importance have tadpoles after Nematocera larvae, but in the second pond Cladocerans have higher amount than tadpoles. The difference is probably caused by the more homogenous distribution of tadpoles than of Cladocerans in the habitat. However, comparing the habitats it seems that the differences between them are due to the situation from the first one and not the second. The smaller size of the pond no.1 leads, as in the case of shad-skin remains and ranids' eggs, to be more tadpoles on the volume unit of the first pond. This fact is confirmed by the average number of preys / newt which is higher in the first habitat (9.8) than in the second (6.5).

At the first and third collecting period the highest amount had the terrestrial preys. In March the newts fed on terrestrial Gastropods from the ponds' banks. At the end of April, the newts foraged again on the ponds' banks but this time Oligochaetas. The other terrestrial preys are faster in terrestrial environment than the newts; most probably they were eaten by newts from water where the preys got accidentally. The percentage of terrestrial items, captured on the land, from the total preys (Oligochaeta, terrestrial Gastropods and Homoptera) is very high at females (8.6%) comparatively with males (2.7%), females being bigger consumers from terrestrial environment. The absence of crests is a disadvantage for them in water so they are forced to forage more intensively on the banks. The amount of terrestrial items, captured in water, from the total preys (Lepidoptera, Curculionidae, Scarabaeidae, Nematocera, Brachycera and Formicidae) is higher at males (1.7% than 1.3% at females).

Conclusions

None of the 245 studied crested newts had empty stomachs. In the stomach contents we identified minerals, vegetal remains and animal preys. The animal type food was represented by molted skins remains of its own species, amphibian eggs and 1822 prey items. The most important preys are Nematocera larvae (P_{total} = 63.5%; F_{total} = 61.2%) and the brown ranids' tadpoles (P_{total} = 11.2%; F_{total} = 23.2%). Most of the preys were from aquatic environment (93.46). The collecting period, newts' sex and age (size) as well as the habitat had strong influences on the newts' feeding. The feeding intensity was higher in the small sized habitat than in the bigger one.

Rezumat

Nici unul din cei 245 de tritoni cu creastă analizați nu au avut stomacuri goale. În conținuturile stomacale am identificat elemente minerale, vegetale şi animale pradă. Hrana de natură animală a fost reprezentată de fragmentele de exuvii ale propriei specii, ponte de amfibieni şi 1822 de prăzi. Cele mai importante prăzi sunt larvele de *Nematocere* ($P_{totală}$ = 63,5 %; $F_{totală}$ = 61,2 %) şi mormolocii de Ranide brune ($P_{totală}$ = 11,2 %; $F_{totală}$ = 23,2 %). Majoritatea prăzilor au fost acvatice (93,46 %). Atât perioada, cât şi sexul, clasa de mărime şi habitatul, au avut puternice influențe asupra hrănirii tritonilor studiați. Intensitate hrănirii este mai mare în habitatul de dimensiuni reduse, în comparație cu cel de dimensiuni mari.

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References

1. ANDREI M., TÖRÖK Z., 1997 - *Addenda to "A bibliographical checklist of Herpetology in Romania"*. Trav. Mus. Natl. Hist. nat. Grigore Antipa, vol. XXXIX: 209-240.
2. ASZALÓS L., BOGDAN H., KOVÁCS É.H., PETER V.I., 2005 - *Food composition of two Rana species on a forest habitat (Livada Plain, Romania)*. N West J Zool, vol 1: 25-30.
3. BURTON T., LIKENS G., 1975 - *Energy flow and nutrient cycle in salamander populations in the Hubbard Brook experimental forest, New Hampshire*. Ecology, 56: 1068-1080.
4. CICORT-LUCACIU A. ŞT., CUPŞA D., NAGHI N., GROZA M., CEREŞAN O., 2004 - *Analiza spectrului trofic al unei populații de Triturus cristatus din zona Sacalasău (dealurile Dernei, județul Bihor, România)*. An. Univ. Oradea, Fasc. Biologie, Tom XI: 91-96.
5. CICORT-LUCACIU A. ŞT., COVACIU-MARCOV S.D., CUPŞA D., PURGEA I., SAS I., 2005a -

Research upon the trophic spectrum of a Triturus cristatus (Laurentus 1768) population in the Briheni area (County of Bihor, Romania). Scientific Annals of the Danube Delta Institute, Tulcea, vol. 11: 2-8.

6. CICORT-LUCACIU A. ŞT., ARDELEANU A., CUPŞA D., NAGHI N., DALEA A., 2005b - *The trophic spectrum of a Triturus cristatus (Laurentus 1768) population from Plopiş Mountains area (Bihor County, Romania)*. N West J Zool., vol. 1: 31-39.
7. CICORT-LUCACIU A.Şt., BOGDAN L., TOTH A., ORBAN I., BĂRBUŢA O., 2006 - *Note about the feeding of a Triturus cristatus population from Şuştiu (Bihor county, România)*. An. Univ. Oradea, Fasc. Biologie, Tom XIII: 24-28.
8. COVACIU-MARCOV S.D., CUPŞA D., TELCEAN I., 2001a - *Contribuţii la cunoaşterea spectrului trofic al speciei Triturus cristatus Laurentus din regiunea Oradea*. An. Univ. Oradea: 119-142.
9. COVACIU-MARCOV S.D., CUPŞA D, TELCEAN I, CICORT A.Şt., 2001b - *Studiul spectrului trofic al unor populaţii Triturus cristatus (Laurentus 1768) din zona dealurilor Tăşadului (jud. Bihor)*. Nymphaea, Folia naturae Bihariae, Oradea, vol. XXIX: 117-144.
10. COVACIU-MARCOV S.D., CUPŞA D., TELCEAN I., CICORT A.Şt., 2002a - *Spectrul trofic al unei populaţii de Triturus cristatus (Amfibia, Urodela) din zona Şerghiş, jud. Bihor, România*. Oltenia, Studii şi Comunicări, Ştiinţele Naturii, Craiova, vol. XVIII: 188-194.
11. COVACIU-MARCOV S.D., CUPŞA D., TELCEAN I., CICORT A.Şt., 2002b - *Studiul spectrului trofic al unor populaţii de Triturus cristatus (Laurentus 1768) din zona dealurilor Tăşadului (Jud. Bihor)*. Nymphaea, Folia Naturae Bihariae, Oradea, vol. XXIX: 117-143.
12. COVACIU-MARCOV S.D., CUPŞA D., CICORT A. ŞT., TELCEAN I., SAS I., 2002c - *Contribuţii la cunoşterea spectrului trofic al speciei Triturus cristatus (Amphibia, Urodela) din regiunea Marghita şi Munţii Pădurea Craiului (Jud. Bihor, România)*. An. Univ. Oradea, Fasc Biologie, Tom IX: 95-108.
13. COVACIU-MARCOV S.D., CUPŞA D., TELCEAN I., CICORT A.Şt., 2002d - *Contribuţii la cunoaşterea spectrului trofic al unor populaţii de Triturus cristatus (Amphibia, Urodela) din depresiunea Beiuşului*. Analele Ştiinţifice ale U S M F "Nicolae Testemiţanu", vol. 1: 97-104.
14. COVACIU-MARCOV S.D., CUPŞA D., SAS I., GHIRA I., 2002e - *The study of the trophic spectrum of two populations of Rana arvalis Nills., 1842 from the north of Bihor county*. Analele Ştiinţifice ale Universităţii "Al. I. Cuza" Iaşi: 160-171.
15. COVACIU-MARCOV S.D., CUPŞA D., SAS I., TELCEAN I., 2003a - *Spectrul trofic al unei populaţii de Rana arvalis (Nilsson 1842) din zona Văşad, Jud. Bihor, România*. Satu-Mare, Studii şi Comunicări, Seria Ştiinţele Naturale, II-III: 170-181.
16. COVACIU-MARCOV S. D., CUPŞA D., CICORT A., NAGHI N., VESEA L., 2003b - *Date despre spectrul trofic al unor populaţii de Triturus alpestris din zona Muntelui Şes (jud. Bihor, România)*. Oltenia, Studii şi Comunicări, Ştiinţele Naturii, vol. XIX: 171-176.
17. COVACIU-MARCOV S.D., SAS I., CUPŞA D., CICORT-LUCACIU A.Şt., ZSURKA R., 2004 - *Spectrul trofic al unei populaţii nehibernante de Rana ridibunda Pallas 1771 din habitatul termal de la Livada (Jud. Bihor, Romania)*. Muzeul Olteniei Craiova, Oltenia, Studii şi Comunicări Ştiinţele Naturii, vol XX: 258-264.
18. COVACIU-MARCOV S.D., GHIRA I., CUPŞA D., SAS I., 2005a - *Feeding habits of Rana ridibunda Pallas 1771 (Anura, Ranidae) during winter at thermal sources from Bihor County (Romania)*. Russian Journal of Herpetology, vol. 12, nr. 2: 87-93.
19. COVACIU-MARCOV S.D., SAS I., CUPŞA D., ROIS R., BOGDAN H., 2005b - *The trophic spectrum of a population of Bufo viridis (Amphibia) from the campus of the University of Oradea*. România.
20. COGĂLNICEANU D., ANDREI M., 1992 - *A bibliographical cheklist of Herpetology in Romania*. Trav. Mus. natl. Hist. nat. Grigore Antipa, vol. XXXII: 331-346.

21. CRIŞAN A., CUPŞA D., 1999 - *Biologie animală 1: Nevertebrate*. Ed. Convex S.A., Oradea: 1-238.
22. CRIŞAN A., MUREŞAN D., 1999 - *Clasa Insecte, Manual de Entomologie Generală*. Universitatea Babeş-Bolyai, Presa Universitară Clujană: 1-165.
23. GHIURCĂ D., ZAHARIA L., 2005 - *Data regarding the trophic spectrum of some population of Bombina variegata from Bacău county*. N West J Zool., vol 1: 15-24.
24. GUIDALI F., SCALI S., CARETTONI A., FONTANETO D., 1999 - *Feeding habits, niche breadth and seasonal dietary shift of Rana dalmatina in northern Italy*. Current studies in herpetology, Miaud C & Guyetant R (eds), Le Bourget du Lac / France, S.E.H.: 161-166.
25. HODAR J.A., 1997 - The use of regression equations for the estimation of prey length and biomass in diet studies of insectivore vertebrates. Misc. Zool., vol. 20 (2): 1-10.
26. IONESCU M.A., LĂCĂTUŞU M., 1999 – ENTOMOLOGIE. Ed. Didactică şi Pedagogică, Bucureşti: 1-416.
27. KENNETT R., Troy O., 1996 - *Diet of Two frehwater Turtles, Chelodina rugosa and Elseza dentata (Testudines: Chelidae) from the Wet – Dry Tropics of Northern Australia*. Copeia, 2: 409-419.
28. LECLERC J., CURTOIS D., 1993 - *A simple stomach flushing method for ranid frogs*. Herp. Review, 24: 142-143.
29. LEGLER J.N., SULLIVAN L.J., 1979 - *The application of stomach - flushing to lizards and anurans*. Herpetologica, vol. 35: 107-110.
30. MESCHERSKY I.G., 1997 - *The Food Habits of the Iranian Long-Legged Frog (Rana macrocnemis) in North Ossetia*. Advances in Amphibian Research in the Former Soviet Union, 2:111-116.
31. PERRY G., LAMPL I., LERNER A., ROTHENSTEIN D., SHANI N., SIVAN N., WERNER Y.L., 1990 - *Foraging mode in lacertid lizards: variation and correlates*. Amphibia-Reptilia 11: 373-384.
32. RADU G.V., RADU V.V., 1999 - *Zoologia Nevertebratelor*. Ed. Didactică şi Pedagogică, Bucureşti, vol. 2: 1-708.
33. SAS I., COVACIU-MARCOV S.D., CUPŞA D., ASZALOS L., KOVACS E.H., TELCEAN I.C., 2003 - *Data about the trophic spectrum of a population of Rana arvalis of the Andrid area (Satu-Mare County, Romania)*. Universitatea din Bacău, Studii şi Cercetări Ştiinţifice, Biologie, 8: 216-223.
34. SAS I., COVACIU-MARCOV S.D., CUPŞA D., SCHIRCHANICI A., PETER V.I., 2004 - *Trophic spectrum of some Bombina bombina populations from Bihor county*. Nymphaea, Folia Naturae Bihariae: 91-110.
35. SAS I., COVACIU-MARCOV S.D., CUPŞA D., CICORT-LUCACIU A.Şt., POPA L., 2005a - *Food analysis in adults (males/females) and juveniles of Bombina variegata*. Analele Ştiinţifice ale Universităţii "Al.I.Cuza" Iaşi, s. Biologie animală, Tom LI: 169-177.
36. SAS I., COVACIU-MARCOV S.D., POP M., ILE R.D., SZEIBEL N., DUMA C., 2005 - *About a closed hybrid population between Bombina bombina and Bombina variegata from Oradea (Bihor County, Romania)*. N West J Zool., vol. 1: 41-60.
37. WELDON P.J., DEMETER B.J., ROSSCOE R., 1993 - *A survey of shed skin-eating (dermatophagy) in Amphibians and Reptiles*. J. Herpetol., 27: 219-228.
38. WHITAKER J., RUBIN O.D., MUNSEE J.R., 1977 - *Observation on food habits of four species of spadefoot toads, genus Scaphiopus*. Herpetologica, 33: 468-475.

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THE ANALYSIS OF THE TROPHIC SPECTRUM IN 3 POPULATIONS OF *BOMBINA VARIEGATA* IN THE SOUTH-WEST OF DEPRESIUNEA BEIUSULUI

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ABSTRACT

PETER V.I., LAZĂR V., DAVID A.M., TOADER S., ANGHEL F., 2006 - The analysis of the trophic spectrum in 3 populations of *Bombina variegata* in the south-west of Depresiunea Beiusului. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 423-430.

The 3 populations studied here have been analyzed following variations of the trophic spectrum, according to the period when they were collected, also to their sex and size. In their stomach we have identified animal food – Colembola, Coleoptera, Nematocera, Hymenoptera – Formicida, Efemeroptera larvae, Gasteropoda and Araneida, but also vegetal and mineral food, and moult fragments. The presence of the order/taxa is related to the season, depending of the biotope, as a result of the changing abiotic factors. Also, the yellow-belly frog analyzed proved they were able to adapt their feeding capacity to the biotope they lived in. There are some differences in the trophic spectrum established by sex and sizes, which are clear as far the feeding process is concerned. Females feed more often than males, and young ones, even if they eat in a smaller amount, their food is higher in nutrients. As far as the food composition and the ways of capturing the prey are concerned, we have noticed few differences.

Key words: *Bombina variegata*, prey taxa, feeding, Romania

Introduction

The yellow-belly frog is a European species, living in the Central Europe’s high areas (Szymura, 1993). In Romania, *Bombina variegata* is a common species in the mountains but also in the fields (Cogălniceanu et al., 2000), it is not to be found in the Dobrogea’s high areas, but one can clearly notice it in northern-western Romania. The species can also be noticed in the hilly or mountain areas, even if the altitude is lower than 200 m (Covaciu-Marcov et al., 2003). In Baile Felix – Bihor district, it can even reach 140 m. Exceptionally, the yellow belly frog was found even at 100 m (Madej, 1964). But this species’ maximum altitude limit in Romania is 1870 m – in Retezat mountains (Stugren & Ghira, 1987).

Bombina variegata lives in small aquatic biotopes, in the temporary ponds from the hilly areas, but one can notice it within different brooks. Also, we have noticed that the species is keen on the vegetation aquation biotopes, where it also clocks. Occasionally, *Bombina variegata* is to be found in those areas where *Bombina bombina* is missing, in large aquatic biotopes (Covaciu-Marcov et al., 2003)

The yellow belly frog is a species whose activity takes place mostly during the night and its activity depends on the rainy, wet periods (Stugren & Rusu, 1978). This species is more terrestrial than *Bombina bombina* (Madej, 1073), and it can be seen at 100 m away from its biotope.

The specific data about the *Bombina variegata* trophic spectrum does not offer too many details (Sârbu 1976, Sas et al. 2004b, Sas et al. 2005 Nemes & Petráss 2003, Ghiurcă & Zaharia 2005, Peter et al. 2005). Even internationally we can say that we have little data about this species’ feeding (Taraščuk 1959, Kminiak 1978, Ščerbak & Ščerban 1980, Kuzmin 1990). Because in our country facts about the yellow belly frog’s trophic spectrum are unavailable, our study wanted to bring an important

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contribution as far as the feeding process is concerned, by referring to.

Material and methods

The 3 *Bombina variegata* populations whose trophic spectrum has been taken into account, are to be found around Briheni, south-west Depresiunea Baiusului, between the latter and Codru-Moma Mountains.

One of the populations lived in a 8 m^2 pond, on a meadow, around Valea Briheni. The pond was 80 cm deep, and the substrate was covered by a thin silt stratum. The biotope is temporary, being supplied by rain and the thawing snow, but, as the weather becomes warmer, the pond will run dry. The biotope is devoid of vegetation of its own, as there is little Dutch rush, but, during spring, the vegetation is richer.

The second population lived in a mountain brook, situated on the edge of a beech forest, Valea Briheni, whose riverbed is covered by cobbles and stones. The depth of the water depends on the sectors, from 10 to 90 cm, and the water runs fast. The brook is permanent; it does not run dry during summer, and its flow will not reduce, which is like a refuge for the species coming from the pond.

The third population lived in a small, but constant flow valley, a Valea Briheni tributary, which had a big organic amount, due to toxic discharge from a distillery. The substrate is like the one in Valea Brihenilor, made of cobbles and stones, and the water runs fast. The water depth is max 50 cm, this level being higher during floods.

Our team analyzed the 3 biotopes (different in point of life conditions), namely 309 types (131 from Valea Briheni, 112 from the pond and 66 from the husks valley), throughout the whole warm season, from April till September 2004. During the research, the evidence was taken once and twice a month, either by hand, where the water level was appropriate, either by a fishing net, with a metal handling.

The stomach content was taken using the lavage method (Cogălniceanu, 1997, Griffiths, 1986, Opatriny, 1980, Dierl, 1978, Legler & Sulivan, 1979, Leclerc & Curtois, 1993), which allowed the study of the Amphibians feeding process, without harming the animals (Cogalniceanu et al., 2000b). After that the animals were released in their biotopes. Our research did not alter the number of the populations.

In order to suppress the stomach content, we have used 20-50 cm^3 syringes. The syringes were set a perfusion tube, having different lengths and sizes (40-60 mm x 1.5-2.5 mm), according to the frog's size. Taking into account the short digestion period, which may have changed the results (Caldwell, 1996), we have tried to shorten as much as possible the time between the catch and the lavage. The samples were preserved separately, in 4% formol, in tight tubes. The tubes were labeled with the type's sex (identified by the lack or presence of the night black callosities from their toes and forearm), size, gathering date and place. All the process took place in a laboratory, using a stereomicroscope. To establish the prey's taxonomic origin, we have used specific data from literature (Moczár et al., 1950, Radu & Radu, 1967, Ionescu et al., 1971, Crişan & Mureşan, 1999, Crişan & Cupşa, 1999).

The trophic spectrum parameters we followed were: the prey's taxonomic origin, the variation of the medium and maximum number of preys/type, the variation of the aquatic and terrestrial preys, the incidence / rate of each prey taxa/order within the species' trophic spectrum, and the how frequently each prey taxa/order was eaten by *Bombina variegata*. These parameters will be analyzed according to the origin biotope, the types' sex and size.

Results and discussions

Over the research, all the 309 analyzed types, in all the 3 biotopes, were found having full stomach content. Their stomachs contained mainly animal food, Invertebrate taxa, and most of all there were: Colembola (due to the fact they are tiny animals, which allows an easy ingestion), then Coleoptera, Nematocera, Hymenoptera- Formicida larvae, Efemeroptera and Gasteropoda larvae. In all the stomach contents we have identified 42 prey taxa standing for 50 prey categories.

Most of the time, the prey taxa in the stomach contents are the ones frequently eaten by the yellow belly frog, and the Coleoptera take the first place. Besides these, we have also found Hymenoptera, Nematocera, Gasteropoda, Colembola and Efemeroptera.

Besides the animal food – the main energy source, we have found stomachs containing vegetal remainders and moults, between 45.63 % and 24.27 %. We also found mineral fragments (0.32 %), but only in the types from Valea Briheni, where most of them were caught on the shore. The presence of the vegetal remainders is due perhaps to the fact that they were ingested accidentally (Whitaker et al., 1977), together with food, or by mistaking them with the animal prey.

Season variations of the trophic spectrum

Temperature is a very important factor in the amphibians life, for their entire activity and feeding process. The temperature is strongly influenced by the season thermic variations.

The density of the vegetal stomachs is not so relevant, as the values are higher according to the frogs' intense feeding period. This may support the idea that the animals have ingested the vegetals and the moults together with animal prey. Therefore, when the samples taken contained a large amount of medium and maximum animal prey, and also a large amount of vegetals and moults, one can notice that the frogs seem to feed more in April, June and August. This may be explained because of the fact that in these periods the frogs' stomachs contained low mobility prey taxons, but highly present in the biotope, so they could be easily caught by the frogs. For example: the Colembola (found in the pond types, due to the proximity to the forest), or the Efemeroptera larvae (the types from the pond and Valea Briheni – 2 biotopes low in organic mass), and the Nematocera larvae (at the types from the husks valley, a high organic mass biotope). This accidental vegetal feeding has been observed in other *Bombina variegata* population research (Sas et al., 2004a, Ghiurcă & Zaharia, 2005, Peter et al., 2005), and also in some frog species, such as: *Rana ridibunda* (Covaciu-Marcov et al., 2000a), *Rana temporaria* (Itamies & Koskela, 1970), *Rana arvalis* (Covaciu-Marcov et al., 2001), *Rana dalmatina* (Aszalos et al., 2005), *Bombina bombina* (Sas et al 2003a).

Tab. 1 - The Frequency of occurence of the consumed preys

F %	Males	Females	Adults	Juveniles	Pop #1	Pop #2	Pop #3
Vegetale	46.2	48.6	47.6	38.1	48.9	37.9	46.4
Exuvie	23.1	26.1	24.8	22.2	19.8	19.7	32.1
Minerale	0.96	0	0.41	0	0.76	0	0
Nematomorfe-Gordius	1.92	0	0.81	0	0.76	0	0.89
Nematode	0	1.41	0.81	0	0.76	1.52	0
Oligochete-Lumbricide	9.62	4.93	6.91	1.59	4.58	0	10.7
Gasteropode-Melci	20.2	19.7	19.9	7.94	4.58	16.7	33
Limax	0	2.11	1.22	0	0	3.03	0.89
Psudoscorpionide	0	0.7	0.41	1.59	0.76	1.52	0
Acarieni	1.92	1.41	1.63	3.17	2.29	1.52	1.79
Araneide	20.2	21.8	21.1	17.5	20.6	18.2	21.4
Crustacee-Izopode	5.77	4.93	5.28	0	5.34	7.58	0.89
Concostracee	0.96	0	0.41	0	0	0	0.89
Ostracode	0	0	0	1.59	0	0	0.89
Amfipode-Gamaride	3.85	6.34	5.28	3.17	6.87	7.58	0.89
Miriapode-Chilopode	1.92	2.11	2.03	0	2.29	1.52	0.89
Diplopode	0.96	0	0.41	0	0	1.52	0
Colembole	10.6	15.5	13.4	15.9	8.4	0	28.6
Efemeroptere-larvă	10.6	12	11.4	11.1	16	6.06	8.93
Efemeroptere-imago	2.88	0	1.22	3.17	3.82	0	0
Odonate	0.96	0	0.41	0	0.76	0	0
Plecoptere-larve	5.77	2.82	4.07	1.59	4.58	7.58	0
Plecoptere-imago	0.96	0.7	0.81	1.59	2.29	0	0
Ortoptere	0	0.7	0.41	0	0.76	0	0
Dermaptere	3.85	1.41	2.44	0	3.05	1.52	0.89
Blatoidee	1.92	0.7	1.22	1.59	1.53	3.03	0
Heteroptere	13.5	8.45	10.6	7.94	11.5	13.6	6.25
Homoptere-Afide	1.92	2.82	2.44	0	3.82	1.52	0
Cicadine	4.81	5.63	5.28	6.35	9.16	6.06	0.89
Coleoptere-larve-nedet.	0.96	1.41	1.22	0	2.29	0	0
Dytiscide-larve	5.77	3.52	4.47	6.35	3.05	0	9.82
Coleoptere-imago-nedet.	46.2	38.7	41.9	47.6	48.9	53	30.4
Dytiscide	0.96	0	0.41	0	0	0	0.89
Carabid	6.73	1.41	3.66	0	3.82	3.03	1.79
Scarabeid	0.96	0.7	0.81	1.59	2.29	0	0
Cantarid	0.96	0	0.41	1.59	0.76	1.52	0

Curculionid	2.88	0.7	1.63	3.17	2.29	3.03	0.89
Coccinelid	1.92	1.41	1.63	0	0.76	4.55	0
Elaterid	2.88	3.52	3.25	0	1.53	6.06	1.79
Stafilinid	1.92	3.52	2.85	3.17	1.53	0	6.25
Silfid	0	0.7	0.41	0	0	0	0.89
Trichoptere-nimfã	0	0.7	0.41	0	0	0	0.89
Trichoptere-imago	3.85	4.23	4.07	4.76	0	0	11.6
Lepidoptere-larvă	7.69	5.63	6.5	4.76	8.4	6.06	3.57
Lepidoptere-imago	2.88	0.7	1.63	1.59	3.05	1.52	0
Brahicere-larve	3.85	6.34	5.28	7.94	3.82	10.6	5.36
Nematocere-larve	8.65	16.9	13.4	15.9	15.3	31.8	1.79
Brahicere-Muscide-imago	15.4	23.9	20.3	15.9	16	30.3	17
Nematocere-Typulide-imago	4.81	1.41	2.85	9.52	6.11	4.55	1.79
Nematocere-Culicide-imago	28.8	19.7	23.6	15.9	26	40.9	6.25
Hymenoptere-nedet.	11.5	7.04	8.94	11.1	13.7	4.55	7.14
Formicide	35.6	30.3	32.5	38.1	34.4	40.9	28.6
Apide	0	0.7	0.41	0	0.76	0	0

The ingestion of the own moults or other types is seen as a recycling mechanism of the epidermis proteins (Weldon et al 1993). In literature, there have been presented more cases where some amfibian species had in their stomach, besides vegetals and animal preys, ground fragments, small stones (Vancea et al., 1961), and even moult pieces (Gunzburger 1999, Sas et al. 2005b). We have also noticed such situations at the *Bombina variegata* populations we studied (Sas et al., 2004b, Sas et al., 2005, Peter et al., 2005)

The amphibians live not only in the aquatic, but also in the terrestrial environment, taking action at the border between the 2 biotopes (Burton & Likens, 1975). But, among the taxons identified in their stomachs, the terrestrial ones are higher (72.7%), despite the fact the yellow belly frog is an Anura species, a strong aquatic type (Fuhn, 1960). The same happened in other such frog species, where again the terrestrial prey was in a larger amount (Low et al., 1990, Covaciu-Marcov et al., 2000, Sas et al., 2003a, Sas et al., 2004 c). These preys have a higher value than the average in April and September (Table 2), because this is a fertile period for the terrestrial taxa/orders. During summer the energy supply is covered by a larger amount of aquatic preys. In August, this amount reaches 51.5%, due to the fact that this period was a rainy one, which made the frogs hunt in the water.

The amount of the most important prey taxa/orders, is different in each month. The Gasteropoda, mainly aquatic types, seem to be higher in April – May (the reproduction period) and August, when terrestrial prey is lower. We have noticed that the Arahnida are eaten throughout the entire research, but more in April (the second gathering), May and June, periods when the feeding process is lower. The spiders, the easiest to catch prey taxons/orders, cover the energy supply. The Colembola, in high number in the stomachs of the frogs we collected in April (when the medium and maximum number of preys per type is the highest), seem to reduce in number, which may demonstrate that they were not hunted, but ingested together with other prey. The Efemeroptera larvae are to be found in the yellow belly frog's stomach within late summer, in July and August, when the terrestrial prey is lower. On the other side, The Coleoptera were identified throughout the entire research period, with the highest values in May and June. The Nematocera larvae were found in the stomachs throughout the entire period, starting with May, due to the fact that they are easy to catch. The adult types reach high values in the stomachs of the frogs captured in July and September. The Hymenoptera, especially the Formicida, were eaten in a large amount, as they were present in the content monthly. The Brahicera-imago reach the highest value in May.

The Coleoptera take the first place in the yellow belly frog's 'menu'. These ones, together with Hymenoptera and Arahnida, have a constant value throughout the entire research. Other animal prey, such as Gasteropoda and Nematocera have relatively high values, but they could not be found in the analyzed contents in June and early April. This may be explained by the fact this is an early period for the Nematocera's growth. However, they will be present in the following samples, the mosquitoes and their larvae being an important prey taxon/order for the Bombina variegata types we analyzed.

We may notice the Colembola preys are lower in the samples taken in summer. As with the Efemeroptera, the situation is exactly the opposite, the values being higher in the same period. This phenomenon is not related to a season variation, but because in June and July the types necessary for the research were collected only from the 2 valleys (favourable to Efemeroptera), the pond being dried.

Tab. 2 - Seasonal variations of the percentage of acquatic and terrestrial preys

	21 IV	28 IV	8 V	25 V	16VI	21VII	12VIII	18 IX	MEDIA
% prăzi acvatice	5.45	14	13.9	37.3	26.3	27.8	51.5	16.1	27.29
% prăzi terestre	94.5	86	86.1	62.7	73.7	72.2	48.5	83.9	72.7

Tab. 3 - Variations of the percentage of acquatic and terrestrial preys depending on the sex and age

	Males	Females	Adults	Juveniles
% prăzi acvatice	22.57525	29.34293	26.97484	28.85714
% prăzi terestre	77.42475	70.65707	73.02516	71.14286

The variations of the trophic spectrum according to the biotopes

The biotopes' architecture and their specific abiotic conditions may directly establish differences concerning the fauna, which will set up the types' trophic pattern and, indirectly, some differences in the 3 populations' feeding spectrum.

The differences among the 3 populations become noticeable at the level of the main prey orders' values. The Colembola were found in large amounts in the contents taken from the pond types, but also in the ones from Valea Briheni. This is due to the fact that these biotopes are closer to the forest; the Gasteropoda were found in a large number in the pond types, which is a specific biotope for them; the same happened to the Efemeroptera, which were found in the pond types only in August, after raining, but also in Valea Briheni. However, the Efemeroptera were not to be found in the types from the husks valley, as this biotope lacks in organic supply. The Coleoptera seem to have the same values as the other 3 populations. We expected the Nematocera larvae to be in a larger amount in the population from the husks valley (35.39%), together with organic excess. In the pond, however, being few vegetation – few organic matter, the development conditions are less favourable. The Nematocera adults' amount is related to the number of the larvae in the biotope. This explains the fact that the number of the mosquitoes in the pond types is lower. The Hymenoptera, especially the Formicide, are higher in the types from Valea Briheni, a biotope where the frogs spend most of the time on the shore, as the water is rather deep.

The most frequent seem to be the prey orders / taxa which are the most frequent the respective biotopes (table 1). Also, the 3 populations differ in point of the trophic spectrum, and these values are connected to the clearly different amounts of the terrestrial and aquatic preys. The yellow belly frogs in the pond and Valea Briheni feed, as expected, mostly with terrestrial preys (73.66 and 81.74%). As far as the ones in the husks valley are concerned, the values of the terrestrial preys (58.2%) and the aquatic ones (41.9%) have approximately the same values. This is due to the fact that the valley is rich in Nematocera larvae, easy to catch preys, and also high in energy supply. As for the feeding intensity (taking into account the medium number of preys/each type), or for the existence of the moults and vegetal contents, there are no clear differences within the 3 populations.

Variations of the trophic spectrum according to sex and size

Studying the stomach content of 104 males, 142 females and, respectively, 246 males and 63 young types, we have taken into account the specific features of the feeding process of each of the categories below.

As we know, the females and the young types have a higher energy need to be able to face the reproduction and respectively, the growing process. Therefore, we have made a comparison between the 2 sexes and the adults, and the young types' feeding intensity. As we expected, the medium and the maximum number of preys per type is clearly higher in females. As for the young types, this is not the case, as the number of the preys is lower than with the adults. This may be explained because the young ones tend to eat preys having a high nutritive value, such as the Coleopterans (20.27% in the young types, while the adult contents have only 14.8%).

As one could notice in the case of the trophic spectrum's season variations, presented above, the feeding intensity is related to the incidence of the vegetals and moults stomachs. Therefore, the higher the number of the stomachs having plants fragments or moults (ingested accidentally together with prey animals), the higher the prey contents. This fact explains our results, according to which the females and the adults contain a larger number of vegetals and moults in their stomachs, as compared to male and young types.

Taking into account that the most important orders / taxa, we can conclude that both sexes and size orders' types (ingesting not only gregarious prey – the Colembola, the Nematocera larvae, the Efemeropterae larvae, the Gasteropoda- , but also high mobility prey – the Coleoptera, the Nematocera adults, the Hymenoptera), use the 'sit-and-wait' feeding strategy. They use this strategy for high mobility preys, which they catch when they see them (Perry & Pianka, 1997). But they also use the 'active-foraging' strategy for low mobility preys, with or without group distribution (Huey & Pianka, 1981).

As for the preys' origin environment, we have not recorded great differences between females and males, or between adults and young types. The terrestrial preys in males and adults slowly exceed the ones in females and young types (Table 2).

Conclusions

The stomach contents of all the types we analyzed had not only animal food – Invertebrates, but also vegetal and mineral food, or moult fragments. The Colembola, the Coleoptera, the Nematocera, the Hymenoptera, the Efemeroptera larvae, the Gasteropoda and the Arahneide are the most frequent preys in Bombina variegata we analyzed.

If there are some variations, from month to month , in the yellow belly frog's trophic spectrum, they are connected to the species' ecology itself, as they have a longer activity during the rainy period (Stugren & Rusu, 1978). The prey orders' season variations come as a result of the fact they vary in abundance at the level of the biotopes. This is a consequence of the abiotic factors' changes.

As for the environment conditions, we have made certain trophic spectrum comparisons (within the 3 populations coming from different biotopes), and we could demonstrate the fact that the *Bombina variegata* types did not have food preferences – they are time-server hunters (Torok & Csorgo, 1992) -. Also, we have noticed they can adapt themselves to the biotope they live in. Thus, in the contents analyzed, it is the prey order which is higher in the respective biotope that prevails: in the types from the husks valley we have found more Nematocera larvae and adults, while in those from Valea Briheni we found Coleoptera and Hymenoptera-Fromicida. In the types from the pond, we noticed Coleoptera and Gasteropoda.

The differences established by the size and sex of the analyzed types are not so significant: the females feed more often than the males (to cover the energy necessary to the reproduction), while the young types ingest a lower number of preys, such as the Coleoptera – this order having the highest rate. The Coleopterae have a high nutritive value which may well cover the energy necessary to growth. Not only the females and the males, but also the adults and the young types, use both of the catch / hunt strategies ('active foraging' and ' sit and wait').

Rezumat

Cele trei populații luate în studiul de față au fost analizate urmărind variații ale spectrului trofic în funcție de perioada de colectare, de sexul şi mărimea indivizilor. În conținuturi stomacale am identificat hrană de natură animală – *Colembole*, *Coleoptere*, *Nematocere, Hymenoptere - Formicide*, larve de *Efemeroptere*, *Gasteropode* şi *Araneide*, dar şi hrană de natură vegetală şi minerală sau fragmente de exuvuii. Ponderea şi frecvența taxonilor pradă variază sezonier odată cu abundența lor în habitate ca urmare a modificărilor suferite de factorii abiotici. De asemenea, izvoraşii cu burtă galbenă analizați au dat dovada unei capacități mari de adaptare a spectrului de hrănire la oferta habitatului în care trăiesc. Diferențele de spectru trofic determinate de sex şi mărime sunt evidente în ceea ce priveşte intensitate de hrănire (femelele se hrănesc mai intens decât masculii, iar juvenilii, chiar dacă consumă un număr mai mic de prazi / individ, acestea au o valoare nutritivă crescută care acoperă necesarul energetic mai ridicat), însă în ceea ce priveşte compoziția spectrului de hrănire şi strategiile utilizate în prinderea prăzilor, deosebirile sunt puțin pregnante.

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Bibliografie

1. ASZALÓS L., BOGDAN H., KOVÁCS É.H., PETER V.I., 2005 - *Food composition of two Rana species on a forest habitat (Livada Plain, Romania)*. N West J Zool, vol. 1: 25-30.
2. BURTON T., LIKES G., 1975 - *Energy folow and nutrient cycle in salamander populations in the Hubbard Brook experimental forest, New Hampshire*. Ecology, 56: 1068-1080.
3. CADWELL J.P., 1996 - *The evolution of myrmecophagy and its correlates in poison frogs (Family Dendrobatidae).* J. Zool, London, 240: 75-101.
4. COGĂLNICEANU D., 1997 - *Practicum de ecologie a Amfibienilor – Metode şi tehnici în studiul ecologiei Amfibienilor*. Universitatea din Bucureşti, Bucureşti:1-122.
5. COGĂLNICEANU D., AIOANEI F., BOGDAN M., 2000b - *Amfibienii din*

România, Determinator. Ed. Ars Docendi, Bucureşti: 1-99.
6. COVACIU-MARCOV S.D., CUPŞA D., GHIRA I., 2000a - *Trophical spectrum of a Rana ridibunda Pallas 1771 population from Cefa (Bihor country, Romania)*. Studii şi cercetări, Biologie, 5: 107-115.
7. COVACIU-MARCOV S.D., GHIRA I., VENCZEL M., 2000b - *Contribuţii la studiul herpetofaunei din zona Oradea*. Nymphaea, Folia Naturae Bihariae, Oradea, vol. XXVIII: 143-158.
8. COVACIU-MARCOV S.D., SALA G., SAS I., CICORT A., PUIE T., 2003a - *Studiul unor populaţii de Bombina variegata (Amphibia) din depresiunea Beiuş, jud. Bihor*. An. Univ. Oradea, Fasc. Biologie, vol. 10: 119-130.
9. CRIŞAN A., CUPŞA D., 1999 - *Biologie Animală. I Nevertebrate*. Ed. Convex S.A., Oradea: 1-258.
10. CRIŞAN A., MUREŞAN D., 1999 - *Clasa Insecte, Manual de Entomologie generală*. Presa Universitară Clujeană, Cluj-Napoca: 1-165.
11. DI CERBO A.R., FERRI V., 2000 - *Osservazioni sulle modalita riproduttive di quattro specie sintopiche di Anfibi in Valle Seriana, Bergamo*. Atti 1 Congresso S.H.I., Boll. Mus. reg. Sci. nat., Torino: 505-516.
12. DIERL W., 1978 - *Insekten, Libellen, Kafer, Schmetterlinge und andere. BLV*. Verlagsegesellschaft, Munchen: 1-127.
13. FUHN I., 1960 - *Fauna R.P.R, Amphibia*. Ed. Academiei R.P.R., Bucharest, 14 (1).
14. GHIURCĂ D., ZAHARIA L., 2005 - *Data regarding the trophic spectrum of some populations of Bombina variegata from Bacău country*. N West J Zool, vol. 1: 15-24.
15. GRIFFITS R.A., 1986 - *Feeding niche overlap and food selections in Smooth and Palmate Newts, Triturus vulgaris and Triturus helveticus at a pond in Mid-Wales*. Journal of Anim. Ecol., 55: 201-214.
16. GUNZBURNGER S.M., 1999 - *Diet of the Red Hills Salamander Phaeognatus hubrichi*. Copeia, 1992 (2): 523-525.
17. HUEY R.B., PIANKA E.R., 1981 - *Ecological consequences of foraging mode*. Ecology 62 (4): 991-999.
18. IONESCU M.A., LĂCĂTUŞU M., 1971 - *Entomologie*. Editura Didactică şi Pedagogică, Bucureşti.
19. ITÄMIES J., KOSKELA P., 1970 - *On the diet of the common frog (Rana temporaria L.)*. Aquilo Ser. Zool., 10: 53-60.
20. KMINIAK M., 1978 - *Food composition of certain amphibians at the beginning of their seasonal activity*. Acta Fac. Rer. Nat. Univ. Com., Zoologia, Bratislava, 23: 105-114.
21. KUZMIN S.L., 1990 - *Trophic niche overlap in syntopic postmetamorphic amphibians of the Carpathian Mountains (Ukraina: Soviet Union)*. Herpetozoa, vol. 3: 13-24.
22. LECLERC J., CURTOIS D., 1993 - *A simple stomach flushing method for Ranid frogs*. Herp. Review, vol. 24: 142-143.
23. LEGLER J.N., SULLIVAN L.J., 1979 - *The application of stomach-flushing to lizards and anurans*. Herpetologica, vol. 35: 107-111.
24. LŐW P., TÖRÖK J., SASS M., CSÖRGŐ T., 1990 - *Állattani Közlemények*. 76: 79-89.
25. MADEJ Z., 1964 - *Studies on the fire-bellied toad (Bombina bombina) and yellow-bellied toad (Bombina variegata) of upper Silezia and Moravian Gate*. Acta Zoologica Cracoviensia, vol. 3: 291-334.
26. MADEJ Z., 1973 - *Ecology of European fire-bellied toad (Bombina Oken 1816)*. Przgel. Zool. Wroclaw, 17: 200-204.
27. MÓCZÁR L., BALOGH J., DUDICH E., ÉHIK Gy., FEJÉRVÁRY G.-né, GYŐRFI J., LOKSA I., SOÓS Á., STOHL G., WARGA K., WOYNÁROVICH E., 1950 - *Animals determination key I.-II*. Ed. Közoktatásügyi kiadóválalat, Budapest.
28. NEMES Sz., PETRÁSS I., 2003 - *The food of yellow belied toads (Bombina variegata) from two different habitats in Romania*. Zeitshrift für Feldherpetologie, 10: 1-8.
29. OPARTINY E., 1980 - *Food sampling in live Amphibians*. Vest. Cs. Spolec. Zool., 44: 268-271.
30. PETER V., TELCEAN I., SERE E., PURGEA I., BOGDAN H., 2005 - *The comparative analysis of the trophic spectrum of three populations of Bombina variegata from the Şuştiu area (Bihor country, Romania)*. An. Univ. Oradea, Fasc. Biologie, Tom. XII: 63-69.
31. PERRY G., PIANKA E.R., 1997 - *Animal foraging: past, present and future*. TREE., 12 (4): 360-364.
32. RADU G.V., RADU V.V., 1967 - *Zoologia nevertebratelor*. Ed. Didactică şi Pedagogică, Bucureşti, vol. 2.
33. SAS I., COVACIU-MARCOV S.D., CUPŞA D., SCHIRCHANICI A., ASZALÓS L., 2003a - *Research upon the*

trophical spectrum of a Bombina bombina (L. 1761) population from Resighea region (county of Satu-Mare, Romania). Muzeul Olteniei Craiova, Oltenia, Studii şi Comunicări Ştiinţele Naturii, vol. 19: 183-188.

34. SAS I., COVACIU-MARCOV S.D., CUPŞA D., SCHIRCHANICI A., PETER V.I., 2004a - *The study of the trofic spectrum of some Bombina bombina (Linneaus 1761) populations in the Ier Valley area (country of Bihor)*. Nymphaea, Folia Naturae Bihariae, Oradea, vol. 31: 91-109.
35. SAS I., COVACIU-MARCOV S.D., CUPŞA D., KOVÁCS É.H., GABORA M., 2004b - *Data about the trophic spectrum of a population of Bombina variegata of the Vârciorog area (Pădurea Craiului Mountains, Bihor county, Romania)*. Studii şi Cercetări, Biologie, Bacău, vol. 9: 124-130.
36. SAS I., KOVÁCS É.H., PETER V., CUPŞA D., ANTAL B., 2004 - *Hrănirea unei populaţii nehibernante de Rana ridibunda Pall. 1771.* Analele Universităţii din Oradea, Fasc Biologie, vol. 11: 83-90.
37. SAS I., COVACIU-MARCOV S.D., CUPŞA D., CICORT-LUCACIU A.Şt., POPA L., 2005a - *Food analysis of adults (males / females) and juveniles of Bombina variegata*. Analele Ştiinţifice ale Universităţii "Al. I Cuza", Biologie Animală, vol. 51: 169-177
38. SAS I., COVACIU-MARCOV S.D., POP M., ILE R.D., SZEIBEL N., DUMA Cr., 2005b - *About a closed hybrid population between Bombina bombina and Bombina variegata from Oradea (Bihor county, Romania).* North-Western Journal of Zoology, vol. 1: 41-46
39. ŠČERBAK N.N., ŠČERBAN N.I., 1980 - *Amphibians and Reptiles of Ukrainian Charpatians*. Kiev, Ed. Nankova Dunka.
40. SÎRBU D., 1976 - *Contribuţii la cunoaşterea hranei la Bombina variegata din împrejurimile oraşului Cluj-Napoca*. Studia Univ. Babes-Bolyai, Biol., vol. 21: 65-70.
41. STUGREN B., GHIRA I., 1987 - *Uber Amphibien und Reptilien der Oberen Waldgrenze im Retezat-Gebirge*. Studia, Univ. Babes-Bolyai, Ser. Biol., vol. XXXII: 50-58.
42. STUGREN B., RUSU R., 1978 - *Ritmul circadian al bihaiului de baltă cu burta galbenă, Bombina variegata (L.) din România*. Nymphaea, Folia Naturae Bihariae, Oradea, vol. VI: 535-544.
43. SZYMURA J.M., 1993 - *Analysis of hybrid zones whit Bombina*. In hybrid zones and the evolutionary process (ed. R.G. Harrison), Oxford University Press: 261-289.
44. TARAŠČUK J.V., 1959 - *Fauna Ukraini 7*. Zemnovodni ta plauzi, Kijev.
45. TÖRÖK J., CSÖRGŐ T., 1992 - *Food composition of the three Rana species in Kis-Balaton Nature reserve*. Opusc Zool., Budapest, vol. 25: 113-123.
46. VANCEA Şt., MÎNDRU C., SIMIONESCU V., 1961 - *Contribuţii la cunoaşterea hranei la Rana ridibunda din împrejurimile oraşului Iaşi*. Stud. şi Cerc. Şt Acad. R.P.R., Fil. Iaşi, Biol. şi Şt. Agric., 1: 111-120.
47. WELDON P.J., DEMETER B.J., ROSSCOE R., 1993 - *A survey of shed skind-eating in Amphibians and Reptiles*. J. Herpetol. 27: 219-228.
48. WITAKER J., RUBIN O.D., MUNSEE J.R., 1977 - *Observations of food habits of four species of spadefoot toad, genus Scaphiopus*. Herpetologica, vol. 33: 468-475.

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DATA REGARDING THE TROPHIC SPECTRUM OF SOME POPULATION OF *BOMBINA VARIEGATA* FROM NEMIRA MOUNTAINS (BACĂU COUNTY)

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ABSTRACT

GHIURCĂ D., ZAHARIA L. - Data regarding the trophic spectrum of some population of *Bombina variegata* from Nemira Mountains (Bacău county). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 431-436.

We analyzed the trophical spectrum of three *Bombina variegata* populations, from forest ecosystems placed in Bălătău, Poiana Sărată and Slănic Moldova within Bacău County. The most abundant prey taxon in the food of *Bombina variegata* populations is represented by the species from Coleoptera order, followed by those of Hymenoptera and Diptera among insects, and by araneids among spider. The considerable number of small and gregarious species (Formicidae – Hymenoptera) emphasizes the opportunistic behavior of preying in this species, using the *sit and wait* foraging behavior. The terrestrial prey taxons prevail in comparison with aquatic organisms. Like the other amphibian species, *Bombina variegata* is a zoophagous – polyphagous species. Yellow-bellied toads eat all moving objects in their sight range that they can ingest.

Key words: amphibians, *Bombina variegata*, trophic spectrum.

Introduction

The species *Bombina variegata* belongs to the family Discoglossidae from Anura order, being a common species in Romania spread at altitudes between 200-1500 m (Cogălniceanu et al. 2000).

The studies regarding the stomach content at *Bombina variegata* are poor in Romania. (Sas et al. 2004, Ghiurcă & Zaharia 2005, Ghiurcă et al. 2006). From this point of view we aim to bring new data regarding the food of this species.

The study was undertaken in three forest ecosystems from Nemira Mountains (Bălătău, Poiana Sărată and Slănic Moldova). The research was focused on the taxonomic groups which represent the prey of yellow-bellied toad (both the number of species and specimens), and also, on the occurrence frequency of different categories of organisms.

Material and methods

The samples of *Bombina variegata* were captured in the following locations:

- forest ecosystem Bălătău Lake placed in Nemira Mountains, in south-western part of Bacău county, near Dărmăneşti town;
- forest ecosystem Poiana Sărată, placed in south-estern area of Nemira Mountains;
- forest ecosystem placed at the north of Slănic Moldova town.

We analyzed a number of 70 samples of stomachal content belonging to the species *Bombina variegata*.

The stomachal contents were collected using the stomachal flushing method (Cogălniceanu 1997). Thus were used a syringe with a perfusion tube at one end. Because the frog digestion takes place rapidly we tried to shorten as much as possible the period between capture and stomachal flushing. The water was injected very slowly and gradually due to the small size of the animals which could be easily wounded. This method permits the release of sampled animal in the natural biotope avoiding the populations decrease.

The stomachal contents were collected and preserved in technical alcohol and were identified by

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the use of stereomicroscope and microscope, with specifically identification (Reitter 1912, Paulian 1971, Jeuniaux 1996, Chinery 1998).

Results and discussions

The amphibian diet is mainly made up of invertebrates. Although the adults are regarded as carnivorous animals and only their larvae consume vegetal matter.

The literature considers that the vegetal food is accidentally ingested along with the captured preys. Vegetal debris was, also, recorded in other amphibian's species stomachs, like: *Rana ridibunda* (Covaciu – Marcov et al. 2000), *Bombina bombina* (Sas et al. 2003), *Rana arvalis* (Covaciu – Marcov et al. 2001).

The percentage of stomachs with vegetal debris out of the total number of 70 samples is of 15,71% (tab.1).

Considering that amphibians are predators (Cogălniceanu et al. 2000), the most part of the analyzed stomach, with the exception of three, contain animal food.

The preys that we identified in the stomachal contents are determined to family level. In some specimens it was possible the identification at genus level and even at species level.

We separated the immature forms (larva and pupae, in the case of Culicida family) from adults for the orders Coleoptera, Diptera, Lepidoptera, Homoptera. We made a distinction between the preys with aquatic and terrestrial life environment. The differentiation of these categories is made concerning their movements and the environment in which they were captured.

Specimens from Gasteropoda class were recorded in all habitats (tab. 2). The snails identified in the stomach of the *Bombina variegata* populations studied presented only the shell without the soft body.

There were identified an order (Isopoda) from Crustacea class and two from Miriapoda class: Diplopoda and Chilopoda. Both of these classes are poor represented in the stomachal contents analyzed, these species live in the superficial horizons of the soil and under litter, thus representing preys which are not available food.

The arachnids are a well represented group in the food of the species *Bombina variegata*. Among this class we identified specimens belonging to the following orders: Acarina, Araneea and Opiliones. Out of these three orders the most abundant were the specimens belonging to Aranea order.

Most of the preys identified in the stomachal contents of yellow-bellied toad belong to the class Insecta.

The order Heteroptera is well represented in the diet of the studied population of *Bombina variegata*.

Out of Coleoptera order we identified both adults and larvae, representing the most part of the prey consumed by yellow-bellied toad. In the analyzed stomachs we identified specimens belonging to 8 families: Hydrophilidae, Carabidae, Staphylinidae, Scarabeidae, Elateridae, Curculionidae, Coccinelidae and Cantharidae. In some specimens it was possible the identification at genus level – *Ontophagus* sp., *Amara* sp., *Calathus* sp., *Notiophilus* sp., *Athous* sp. and even at species level – *Harpalus aeneus*, *Agriotes ustulatus* şi *Thea 22-punctata*.

Among the hymenopterans we identified the families Formicidae, Tenthredinidae, Cynipidae and Ichneumonidae. There was identified at species level only *Formica rufa*.

Both adults and larvae were identified in the case of some families like: Stratiomyidae, Culicidae, Muscidae, Tipulidae, Mycetophlidae, Phoridae, Chironomidae, Calliphoridae, Syrphidae and Helemyzidae belonging to the Diptera order which is well consumed by the populations of *Bombina variegata* analyzed by us.

We, also, identified mature and immature stages of specimens from the following orders: Colembola, Dermaptera, Lepidoptera, Homoptera, Neuroptera, Odonata and Orthoptera.

The number of taxons identified in the stomachal content of the studied populations reaches a total of 268 and is distributed as following: 115 for the population studied in the Bălătău area, 95 for the samples collected in forests ecosystem from Poiana Sărată and 58 for the yellow-bellied toad population from Slănic Moldova forest (fig. 1).

The most of prey consumed by the studied populations of *Bombina variegata* belong to Coleoptera order – 20,52% of samples (fig. 2). According to the references coleopterans are important prey for yellow-bellied toad (Kuzmin 1990).

The second group from the number of specimens point of view is order Hymenoptera – 52 specimens (19,4 % out of total prey) (fig. 2). These data emphasize that the species from this order represents important preys for analyzed *Bombina variegata* populations.

Considering the number of prey, the third important group includes species of Diptera order – 46 specimens, representing 17,16% out of the total number of samples (fig. 2).

Beside the abundance of prey taxons another important parameter for the stomachal content study is represented by the frequency of prey. This index is defined as the rapport between the number of analyzed stomach with a specifical prey taxon and the total number of studied stomachs, resulting in a percentile value.

The large amount of these taxonomical groups' specimens is related with the high abundance of specimens in forests ecosystem for ground beetles and spiders and for diptera species due to the preferences for moist microhabitats.

An important parameter is the life environment of the prey taxons consumed by *Bombina variegata,* which is a species related to the aquatic ecosystems (Fuhn 1960). We identified preys both from aquatic and terrestrial environments in the analyzed stomachs (tab. 2). The terrestrial organisms prevailed in this species diet in all three sampled populations of *Bombina variegata*.

Conclusions

Out of the total number of analyzed stomachs only one was empty, this lead us to the conclusion that the life conditions from the studied areas are favorable to the feeding of the yellow-bellied toad populations from this region.

We identified a large number of stomachs with vegetal debris. The most probable explanation is that they were accidentally ingested along with the animal prey, this is proved by the fact that the number of stomachs with vegetal debris rises along with feeding frequency.

The most abundant prey taxon in the food of *Bombina variegata* populations is represented by the species from Coleoptera order, followed by those of Hymenoptera and Diptera.

The considerable number of small and gregarious species (Formicidae – Hymenoptera) emphasizes the opportunistic behavior of preying in this species, using the *sit and wait* foraging method (Perry & Pianka 1997).

The terrestrial prey taxons prevail in comparison with aquatic organisms.

Like the other amphibian species, *Bombina varigata* is a zoophagous – polyphagous species. Yellow-bellied toads eat all moving objects in their sight range that they can ingest. This species does not show any preferences towards prey, with the conditions of observing the prey and of good-sized for being swallowed.

Tab. 1 - The percentage of stomachs with: vegetal debris, only with vegetal matter, with egg laying fragments, only with egg laying fragments, and with animal food

	Number of analyzed stomachs	Percent of stomachs with vegetal matter	Percent of stomachs only with vegetal matter	Percent of stomachs with egg laying fragments	Percent of stomachs only with egg laying fragments	Percent of stomachs with animal food	Procent of empty stomachs
Total	70	28,57%	1,43%	15,71%	1,43%	95,71%	1,43%

Tab. 2 - The amount and frequency of prey taxons for each sample area

Group	**Samples area**						**Total**		**Life environment**
	Bălătău Lake		**Poiana Sărată**		**Slănic Moldova**				
	Nr.	**Freq. (%)**	**Nr.**	**Freq. (%)**	**Nr.**	**Freq. (%)**	**Nr.**	**Freq. (%)**	
Gasteropoda	**4**	**3,46**	**4**	**4,21**	**3**	**5,17**	**9**	**4,11**	**aquatic**
Clitellata - total	**3**	**2,6**	**5**	**5,26**			**8**	**2,98**	
Oligocaeta	3	2,6	5	5,26			**8**	**2,98**	**terrestrial**
Crustacea - total	**7**	**6,08**	**8**	**8,42**	**1**	**1,72**	**16**	**5,97**	**terrestrial**
Isopoda	7	6,08	8	8,42	1	1,72	**16**	**5,97**	**terrestrial**
Miriapoda – total	**7**	**6,08**	**2**	**2,1**			**9**	**3,36**	**terrestrial**
Miriapoda – unid.			1	1,05			**1**	**0,37**	**terrestrial**
Diplopoda	6	5,22	1	1,05			**7**	**2,61**	**terrestrial**
Chilopoda	1	0,87					**1**	**0,37**	**terrestrial**
Arahnida – total	**14**	**12,17**	**5**	**5,26**	**7**	**12,07**	**26**	**9,7**	**terrestrial**
Acarina	1	0,87					**1**	**0,37**	**terrestrial**
Araneea – unid.	10	8,69	5	5,26	4	6,89	**19**	**7,09**	**terrestrial**
Opiliones – unid.	3	2,6			3	5,17	**6**	**2,24**	**terrestrial**
Cls. Insecta – total	**80**	**69,56**	**71**	**74,73**	**47**	**81,03**	***198***	***73,88***	
Heteroptera – total	**3**	**2,6**	**3**	**3,16**			**6**	**2,24**	**terrestrial**
Heteroptera – unid.			3	3,16			**3**	**1,12**	**terrestrial**
Miridae	3	2,6					**3**	**1,12**	**terrestrial**
Colembola – total	**4**	**3,48**	**2**	**2,1**			**6**	**2,24**	**terrestrial**
Colembola – unid.	4	3,48	2	2,1			**6**	**2,24**	**terrestrial**
Coleoptera – total	**22**	**19,13**	**26**	**27,36**	**7**	**12,07**	**55**	**20,52**	

Coleoptera – unid.	1	0,87	1	1,05			**2**	**0,75**	**terrestrial**
Coleoptera -larvae	1	0,87					**1**	**0,37**	**terrestrial**
Hydrophilidae - larvae			1	1,05			**1**	**0,37**	**aquatic**
Carabidae – unid.	3	2,6	5	5,26	1	1,72	**9**	**3,36**	**terrestrial**
Carabidae - larvae	1	0,87	13	13,68	5	8,62	**19**	**7,09**	**terrestrial**
Staphylinidae – unid.	1	0,87	2	2,1			**3**	**1,12**	**terrestrial**
Scarabeidae	1	0,87	1	1,05			**2**	**0,75**	**terrestrial**
Elateridae	3	2,6					**3**	**1,12**	**terrestrial**
Curculionidae	9	7,83	2	2,1	1	1,72	**12**	**4,48**	**terrestrial**
Coccinelidae	2	1,73					**2**	**0,75**	**terrestrial**
Cantharidae			1	1,05			**1**	**0,37**	**terrestrial**
Hymenoptera – total	**21**	**18,26**	**23**	**24,21**	**8**	**13,79**	**52**	**19,4**	**terrestrial**
Hymenoptera – unid.	1	0,87					**1**	**0,37**	**terrestrial**
Formicidae	1	0,87					**1**	**0,37**	**terrestrial**
Formicidae – unid.	17	14,78	22	23,16	7	12,07	**46**	**17,16**	**terrestrial**
Tenthredinidae					1	1,72	**1**	**0,37**	**terrestrial**
Cynipidae	2	1,73					**2**	**0,75**	**terrestrial**
Ichneumonidae			1	1,05			**1**	**0,37**	**terrestrial**
Diptera – total	**11**	**9,56**	**9**	**9,47**	**26**	**44,83**	**46**	**17,16**	
Diptera – unid.	1	0,87			3	5,17	**4**	**1,49**	**terrestrial**
Diptera - larvae	1	0,87	5	5,26			**6**	**2,24**	**terrestrial**
Stratiomydae - larvae	1	0,87	2	2,1			**3**	**1,12**	**terrestrial**
Culicidae					1	1,72	**1**	**0,37**	**aquatic**
Culicidae - larvae	1	0,87	1	1,05			**2**	**0,75**	**aquatic**
Culicidae - pupae	1	0,87			2	3,45	**3**	**1,12**	**aquatic**
Muscidae	2	1,73					**2**	**0,75**	**terrestrial**
Tipulidae	1	0,87			4	6,89	**5**	**1,86**	**aquatic**
Mycetophylidae					9	15,52	**9**	**3,36**	**terrestrial**
Phoridae	2	1,73	1	1,05	3	5,17	**6**	**2,24**	**terrestrial**
Chironomidae – larvae	1	0,87					**1**	**0,37**	**aquatic**
Calliphoridae					2	3,45	**2**	**0,75**	**terrestrial**
Syrphidae					1	1,72	**1**	**0,37**	**terrestrial**
Helemyzidae					1	1,72	**1**	**0,37**	**terrestrial**
Dermaptera – total	**7**	**6,08**					**7**	**2,61**	**terrestrial**
Forficulidae – unid..	7	6,08					**7**	**2,61**	**terrestrial**
Lepidoptera – total			**7**	**7,37**	**1**	**1,72**	**8**	**2,98**	**terrestrial**
Lepidoptera - larvae			3	3,16	1	1,72	**4**	**1,49**	**terrestrial**
Noctuidae - larvae			2	2,1			**2**	**0,75**	**terrestrial**
Geometridae - larvae			2	2,1			**2**	**0,75**	**terrestrial**
Homoptera - total	**9**	**7,83**			**2**	**3,45**	**11**	**4,1**	**terrestrial**
Aphrophoridae	2	1,73			1	1,72	**3**	**1,12**	**terrestrial**
Cicadelidae	3	2,6					**3**	**1,12**	**terrestrial**
Aphidae	2	2,6			1	1,72	**4**	**2,49**	**terrestrial**
Crysopidae	1	0,87					**1**	**0,37**	**terrestrial**
Neuroptera - total					**1**	**1,72**	**1**	**0,37**	**terrestrial**
Raphidiidae					1	1,72	**1**	**0,37**	**terrestrial**
Odonata	**1**	**0,87**	**1**	**1,05**	**1**	**1,72**	**3**	**1,12**	**terrestrial**
Orthoptera - total	**2**	**1,73**			**1**	**1,72**	**3**	**1,12**	**terrestrial**
Orthoptera – unid.	1	0,87			1	1,72	**2**	**0,75**	**terrestrial**
Orthoptera – larvae	1	0,87					**1**	**0,37**	**terrestrial**

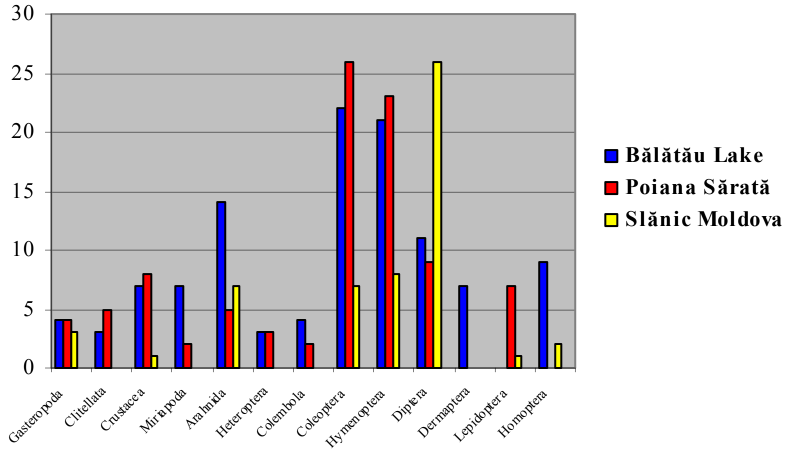

Fig. 1 - Quantitative variations of the prey taxons in studied areas

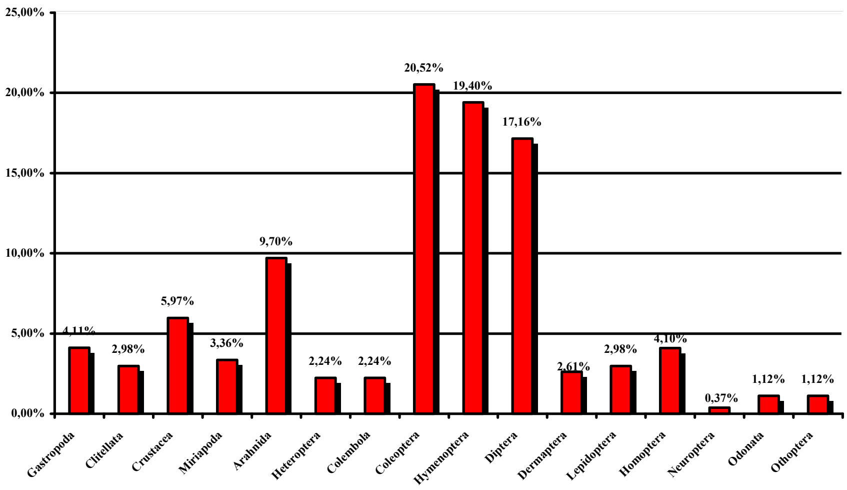

Fig. 2 - Quantitative variations of the prey taxons

Rezumat

Am analizat spectrul trofic a trei populații de *Bombina variegata* din ecosisteme de pădure situate în preajma Lacului Bălătău şi a localităților Poiana Sărată şi Slănic Moldova din județul Bacău. Cei mai abundenți taxoni pradă în hrana populațiilor de *Bombina variegata* analizate sunt reprezentați de ordinul Coleoptera, urmat de Hymenoptera şi Diptera dintre insecte şi de Araneea dintre arahnide (păianjeni). Numărul considerabil de exemplare al unor specii mici şi gregare (Formicidae – Hymenoptera) găsite în hrana izvoraşului cu burtă galbenă ne arată comportamentul oportunist al acestei specii care foloseşte metoda *sit and wait*. Taxonii pradă ce trăiesc în mediul terestru sunt în număr mult mai mare în comparație cu organismele acvatice. Ca şi alte specii de amfibieni, *Bombina variegata* este o specie zoofagă – polifagă. Izvoraşul cu burtă galbenă consumă toate obiectele în mişcare care trec prin raza lor şi pot fi înghițite.

References

1. CHINERY M., 1998 - *Collins guide to the insects of Britain and Western Europe*. HarperCollins Publishers, London;
2. COGĂLNICEANU D., 1997 -*Practicum de ecologie a amfibienilor – metode şi tehnici în studiul ecologiei amfibienilor*. Universitatea din Bucureşti, Bucureşti;
3. COGĂLNICEANU D., AIOANEI F., BOGDAN M., 2000 - *Amfibienii din România*. Determinator, Ed. Ars Docendi, Bucureşti;
4. COVACIU-MARCOV S.-D., CUPŞA D., GHIRA I., 2000 - *Trophical spectrum*

of a Rana ridibunda ridibunda Pallas 1771 population from Cefa (Bihor county, România). Studii şi cercetări, Biologie, **5**. 107-115;
5. COVACIU-MARCOV S.-D., CUPŞA DIANA, SAS I., GHIRA I., 2001a - *The study of the trophic spectrum of two population of Rana arvalis Nills 1842 from the north of Bihor county*. Analele Univ. „Al. I. Cuza", Iaşi 160-171;
6. COVACIU-MARCOV S.-D., CUPŞA DIANA, TELCEAN I., 2001b - *Contribuţii la cunoaşterea spectrului trofic al speciei Triturus cristatus Laurentus din regiunea Oradea*. Analele Universităţii din Oradea, Fasc. Biologie, 8: 119-142;
7. COVACIU-MARCOV S.-D., CUPŞA D., TELCEAN I., CICORT A., 2002 - *Studiul spectrului trofic al unor populaţii de Triturus cristatus (Laurentus 1768) din zona Dealurilor Tăşadului (jud. Bihor).* Nymphaea, Folia naturae Bihariae, 29: 117-143;
8. COVACIU-MARCOV S.-D., CUPŞA D., SAS I., TELCEAN I., 2003 - *Spectrul trofic al unei populaţii de Rana arvalis (Nilsson 1842) din zona Văşad, Jud. Bihor, România*. Studii şi Comunicări, Seria Ştiinţele Naturale 2001 – 2002, Satu – Mare, **1-2**: 170-181;
9. CRISTEA E., CRISTEA A., DEMETRIUC B., 1972 - *Consideraţii cu privire la hrana naturală a broaştelor verzi de lac (Rana ridibunda Pall. şi Rana esculenta L.) din lunca şi delta Dunării*. Bu. Cerc. Piscicole **31** (3-4): 19-23;
10. FUHN I. E., 1960 - *Fauna R.P.R. – Amphibia*. vol. XIV, fascicula 1, Ed. Acad. R.P.R., Bucureşti;
11. FUHN I. E., 1969 - *Broaşte, şerpi, şopârle*. Seria Natura şi omul, Ed. Ştiinţifică, Bucureşti;
12. GHIURCĂ D., ZAHARIA L., 2005a - *Data regarding the trophic spectrum of some population of Bombina variegata from Bacău county*. North-Western Journal Of Zoology, vol. I: 15 - 24, Oradea.
13. GHIURCĂ D., ZAHARIA L., GHERGHEL I., 2005b - *Data regarding the trophic spectrum of one population of Bombina variegata from Piatra Neamţ (Neamţ County*). Studii şi cercetări, Biologie 9: 141 – 144, Univ. Bacău, Bacău.
14. HOLMES S. J., 1959 - *The biology of the frog*. New York.
15. HOLZINGER G., KOVACS T., TÖRÖK J., 1996 - *Csigak (Gastropoda) a Kis – Balatoni keteltuek (Amphibia) taplalekaban*. Allattani Kozlemenyek, 81: 59-63.
16. JEUNIAUX C., 1996 - *Faune de Belgique – Elaterides (Elateridae).* Institut Royal des Sciences Naturelles de Belgique, Bruxelles.
17. PAULIAN R., 1971 - *Atlas des larves d'insectes de France*. Paris.
18. PERRY G., PIANKA E. R., 1997 - *Animal foraging: past, present and future*. TREE **12** (4): 360-364.
19. RADU G. V., RADU V. V., 1967 - *Zoologia nevertebratelor*. Vol. 2, Ed. Didactică şi Pedagogică, Bucureşti;
20. REITTER E., 1912 - *Die kafer des deutchen reiches*. Tome IV, Stuttgart.
21. SAS I., COVACIU-MARCOV S.-D., CUPŞA D., ASZALOS L., KOVACS E. H., TELCEAN I., 2003a - *Date asupra spectrului trofic al unei populaţii de Rana arvalis din zona Andrid (Judeţul Satu – Mare, România)*. Studii şi Cercetări, Biologie, **8**: 216-223.
22. SAS I., COVACIU-MARCOV S.-D., CUPŞA D., SCHIRCHANICI A., ASZALOS L., 2003b - *Studiul spectrului trofic al unei populaţii de Bombina bombina (Linnaeus 1761) din zona Resighea (judeţul Satu – Mare, România*). Muzeul Olteniei Craiova, Oltenia, Studii şi Comunicări, Ştiinţele Naturii, 19: 183-188;
23. SAS I., COVACIU-MARCOV S.-D., CUPŞA D., KOVACS E. H., GABORA M., 2004 - *Data about the trophic spectrum of a population of Bombina variegata of the Vârciorog area (Pădurea Craiului Mountains, Bihor county, Romania*. Studii şi Cercetări, Biologie, **9**: 124-130.
24. VANCEA ŞT., MÎNDRU C., SIMIONESCU V., 1961 - *Contribuţii la cunoaşterea hranei la Rana ridibunda din împrejurimile oraşului Iaşi*. Studii şi Cercetări Ştiinţifice, Acad. R.P.R., Fil. Iaşi, Biol. Şi şt. Agric. **1**: 111-120;
25. VARVARA M., ZAMFIRESCU ŞT., NEACŞU P., 2001 - Lucrări practice de ecologie – manual. Editura Univ. "Al. I. Cuza", Iaşi.
26. ZIMKA J. R., 1966 - The predacy of the field frog (Rana arvalis Nills.) and food levels in communities of soilmacrofauna of forest habitats. Ekol. Pol. A, **14**: 589-605.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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CONTRIBUTIONS TO THE STUDY OF THE HERPETOFAUNA FROM THE SUCEAVA RIVER BASIN (SUCEAVA COUNTY, ROMANIA)

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MIHAIL VICTOR HUTULEAC-VOLOSCIUC[†], ISTVAN SAS[‡],
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ABSTRACT

STRUGARIU AL., SAHLEAN T. C-TIN, HUTULEAC-VOLOSCIUC M. V., SAS I., PUSCASU C. M., GHERGHEL I. - Contributions to the study of the herpetofauna from the Suceava river basin (Suceava county, Romania) - Contributions to the study of the herpetofauna from the Suceava river basin (Suceava county, Romania). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 437-446.

The aim of this study was to realize a synthesis of the knowledge regarding the composition and geographical distribution of the herpetofauna from the Suceava river basin (from Suceava County, Romania). During our research we have identified 16 species of amphibians (*Salamandra salamandra, Mesotriton alpestris, Triturus cristatus, Lissotriton montandoni, Lissotriton vulgaris, Bombina bombina, Bombina variegata, Pelobates fuscus, Bufo bufo, Pseudepidalea viridis, Hyla arborea, Rana arvalis, Rana dalmatina, Rana temporaria, Pelophylax lessonae & Pelopxylax ridibundus*) and 8 specie s of reptiles (*Emys orbicularis, Zootoca vivipara, Anguis fragilis, Lacerta agilis, Natrix natrix, Coronella austriaca, Zamenis longissimus şi Vipera berus)* in the investigated region. Except for these, we have identified hybrids between *Bombina bombina* and *Bombina variegata* and between *Pelophylax ridibundus* and *Pelophylax lessonae* (*Pelophylax kl. esculentus*). In total, we have identified 376 localities for the distribution of the herpetofauna in the 36 investigated geographical localities. The most significant results of this study consists in the discovery of numerous *Zootoca vivipara* and *Rana temporaria* situated at low altitudes and populations of Bombina bombina situated at higher altitudes than anywhere else in Romania. Also, *Mesotriton alpestris* is a premier for the research area.

Key words: Suceava river, herpetofauna, reptiles, amphibians, *Mesotriton alpestris, Zootoca vivipara*, geographical distribution

Introduction

The most recent comprehensive study regarding the distribution of Romanian native herpetofauna refers only to Transylvania (Ghira et al, 2002). The distribution of the amphibians and reptiles from Romanian Moldavia has been vaguely described in the two monographs published in the 1960`s (Fuhn, 1960, Fuhn & Vancea, 1961). Acording to recent publications (Iftime, 2005), several species of amphibians and reptiles are vulnerable, threatened or endangered and, in order to establish effective conservation measures, their precise geographical distribution must be known (Ghira et al, 2002). Therefore, in recent years several papers that contain data in regards to the herpetofauna in Moldavia have been published: Covaciu-Marcov et al, 2003 a, Ghiurca et al, 2005, Gherghel & Ile, 2006, Strugariu et al 2006 a, Strugariu et al 2006 b.

The geographical distribution of the herpetofauna from the hydrographic basin of the Suceava river has been mostly studied and described by us in two previously published papers (Strugariu et al, 2006 a, b). Fuhn (1960) and Fuhn & Vancea (1961) described the Romanian herpetofauna in two monographs that also contained data regarding the

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distribution of the native amphibian and reptile species; these monographs also contained scarce information in regards to the herpetofauna from our study region. In 1991, Cogălniceanu published a preliminary report on the national distribution of the native amphibian species, followed by a more complete monograph in 2000. Except for the mentioned papers, there is no other published data regarding the herpetofauna in our study area. The aim of the present paper is to realize a synthesis of the knowledge that concerns the composition and distribution of the herpetofauna in the Suceava river hydrographic basin, based both on the previous publications and our personal field investigations.

Matherial and methods

The field work was carried out in the year 2006, from March to September and covered 36 localities but data collected before august 2006 regarding the distribution of the amphibian species has already been published. In the majority of cases the animals were directly observed but some specimens were captured by hand and subsequently released. Identifying animals killed by local people or by traffic also played a crucial role in our research and all the species mentioned in this study have been personally identified. With the aim of mapping the herpetofauna, the transects method (Cogalniceanu, 1997) was used. The hybrids were determined by their morphological and chromatic characteristics, the determination being made after main features and measurements indicated in the scientific literature (Berger 1966, 1973, Cogălniceanu et al 2000, Csata 1998, Fuhn 1960, Ghira & Mara 2000, Stugren 1980, Szymura 1993). Some amphibian species were identified by examining observed larva. For every quoted species, a list that contains the names of the localities in which they were identified was made, the result being a final list that contains all the new localities for every identified amphibian and reptile species.

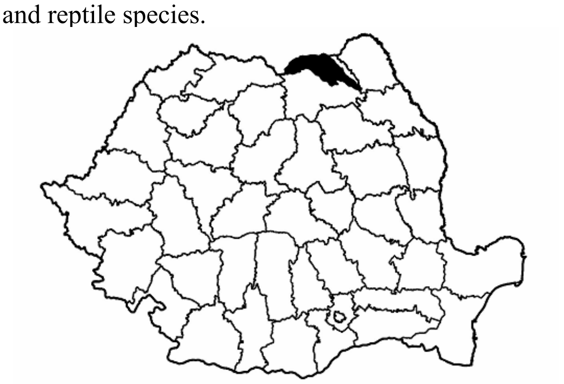

Fig. 1 – The location of the Suceava river basin

The research area is situated in the Nort-Eastern sector of Romania, mostly in the Suceava Plateau but also in areas of the Eastern Carpathians. Most of the hydrographical units consist of rivers and streams but lakes, ponds, swamps and important sub-terrestrial springs are also present (Botnariuc, 1980). In some of the investigated areas, the forests have been cleared, being replaced by agricultural terrain with typical vegetation (Strugariu et al, 2006 a).

Results and disscusions

During our research, 16 amphibian species (*Salamandra salamandra*, *Mesotriton* (ex. *Triturus*) *alpestris, Triturus cristatus, Lissotriton* (ex. *Triturus*) *montandoni, Lissotriton* (ex. *Triturus*) *vulgaris, Bombina bombina, Bombina variegata, Pelobates fuscus, Bufo bufo, Pseudepidalea (*ex. *Bufo) viridis, Hyla arborea, Rana arvalis, Rana dalmatina, Rana temporaria, Pelophylax (*ex. *Rana) lessonae & Pelophylax (*ex. *Rana) ridibundus*), 8 reptile species (*Emys orbicularis, Anguis fragilis, Zootoca vivipara, Lacerta agilis, Natrix natrix, Coronella austriaca, Zamenis longissimus & Vipera berus*) and hybrids between *Bombina bombina* and *Bombina variegata* and between *Pelophylax ridibundus* and *Pelophylax lessonae*: *Pelophylax (*ex. *Rana) kl. esculentus* have been identified. Of these, *Mesotriton alpestris* is cited for the first time in the area. For all the other species, except *Zamenis longissimus* and *Rana arvalis*, this study presents new distribution areas, as showed in table 1. For the species of amphibians and reptiles in the area we have personally identified 376 localities, of which 216 are new localities for the Romanian herpetofauna, in the 36 investigated geographical localities.

Amphibia Linnaeus 1758:

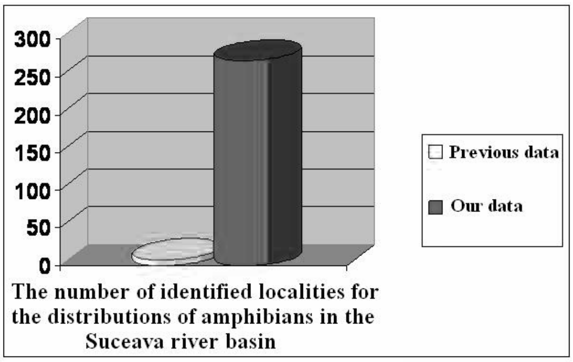

Fig. 2 – The number of previously known and personally identified localities for the distribution of amphibians in the area

Salamandra salamandra Linnaeus 1758

The fire salamander is rare in the Suceava river basin, being mostly encountered in the higher grounds of the area, in or near coniferous or mixed forests.

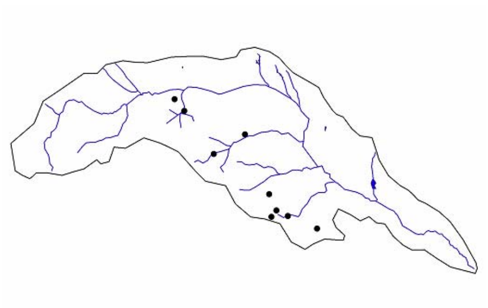

Fig. 3 – Distribution of *Salamandra salamandra*

Mesotriton alpestris Laurentus 1768

The alpine newt is mostly a mountain species, being usually encountered at altitudes between 500-2000m (Fuhn, 1960). This species is a premier of the research area, being identified by us in 2 new localities for the Romanian herpetofauna. Its distribution in the Suceava river basin is very limited due to the fact that few areas are situated at higher altitudes and few areas suit their environmental requirements.

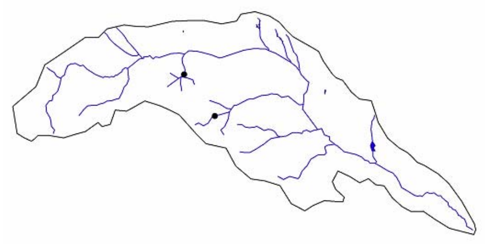

Fig. 4 – Distribution of *Mesotriton alpestris*

Triturus cristatus Laurentus 1768

The crested newt is a fairly common species in the study region, being observed by us in 18 localities, usually in small-medium sized water pools situated in or near deciduous or mixed forests.

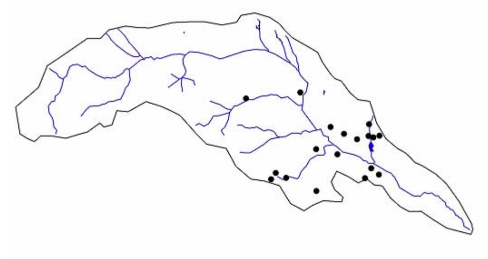

Fig. 5 – Distribution of *Triturus cristatus*

Lissotriton montandoni Boulenger 1880

Montandon`s newt is, like the alpine newt, a very rare species in the area, due to their environmental requirements. We have identified this species in only 4 localities, all of them situated at higher altitudes.

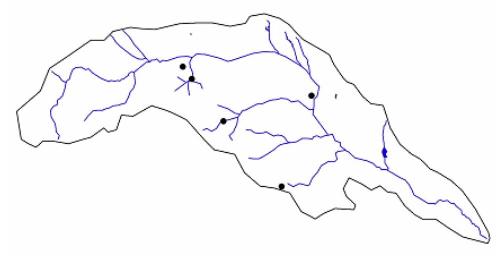

Fig. 6 – Distribution of *Lissotriton montandoni*

Lissotriton vulgaris Linnaeus 1758

The smooth newt is the most common and the most widespread newt species in the research area, being identified by us in 22 localities, in a wide variety of habitats, mostly at lower altitudes.

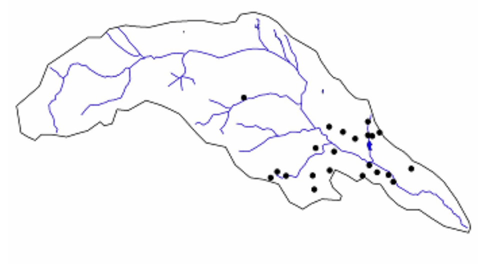

Fig. 7 – Distribution of *Lissotriton vulgaris*

Bombina bombina Linnaues 1761

The fire-bellied toad is a relatively common species in the Suceava river basin, being identified by us in 19 localities. It was mostly recorded at altitudes of around 300m a.s.l. but we also identified this species at around 400 m a.s.l., the latter populations being situated at the species' superior altitude limit.

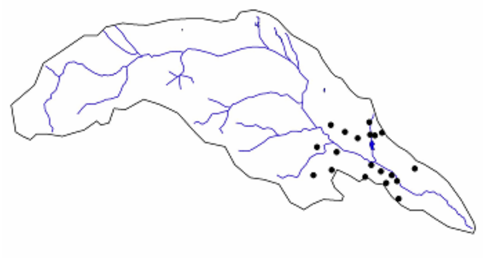

Fig. 8 – Distribution of *Bombina bombina*

Bombina variegata Linnaeus 1758

The yellow belly toad is a very common species in the investigate region, being recorded by us in 25 of the investigated localities. This species seems to not be selective in regards to its habitat, inhabiting almost any type of water pool or moist environment.

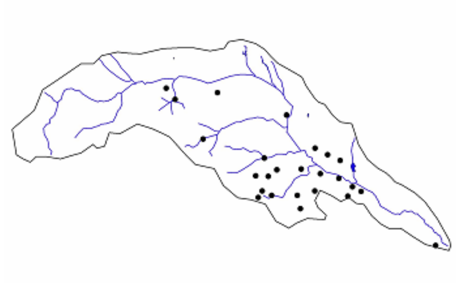

Fig. 9 – Distribution of *Bombina variegata*

<u>*Bombina bombina*</u> X <u>*Bombina variegata*</u>

In 8 localities from the Suceava river basin we have identified hybrids between the two native species of the genus *Bombina*. In western Romania hybrid *Bombina* populations are usualy situated at around 150m ASL (Covaciu-Marcov et al, 2000, 2002, 2003a, b, c, 2004, 2005, 2006) and just above 300m ASL (Ghira et al, 2002) but the hybrids from the Suceava river basin were recorded by us at altitudes of 400m ASL and higher. Therefore, our data suggests that some of the populations of *Bombina* hybrids from our research area are situated at higher altitudes than anywhere else in Romania.

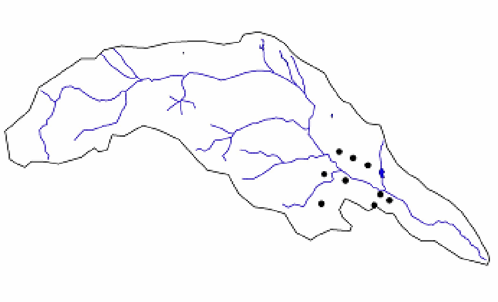

Fig. 10 – Distribution of *Bombina* hybrids

<u>*Pelobates fuscus*</u> Laurentus 1768

The common spade foot toad has only been recorded by us in 2 localities from the research area.

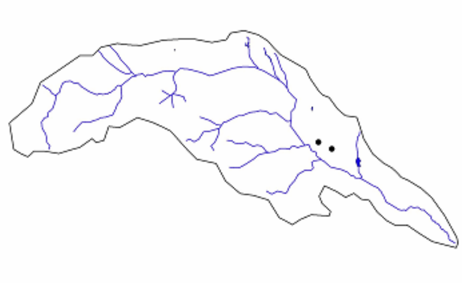

Fig. 11 – Distribution of *Pelobates fuscus*

<u>*Pseudepidalea viridis*</u> Laurentus 1768

The green toad is a common species, especially in the vecinety human dwellings. It was recorded by us in 17 localities from the research areas.

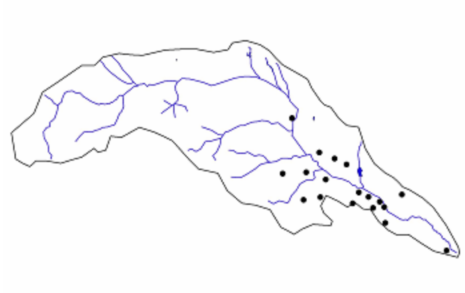

Fig. 12 – Distribution of *Pseudepidalea viridis*

<u>*Bufo bufo*</u> Linnaeus 1758

The common toad is more common and wider spread than the previous species, being recorded by us in 24 localities. Large numbers of specimens from this species fall victim on the communal roads from the research area.

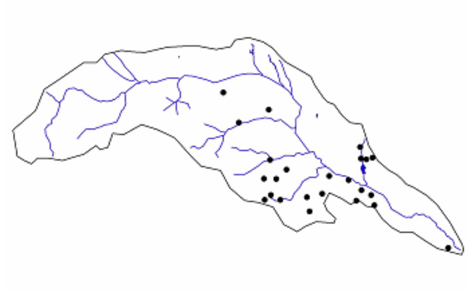

Fig. 13 – Distribution of *Bufo bufo*

<u>*Hyla arborea*</u> Linnaeus 1758

The treefrog is the only arboreal anuran species from Romania (Fuhn, 1969, Cogălniceanu, 2000) and is very common in the research area, being identified by us in 29 localities. It was mostly recorded in or near wooded areas.

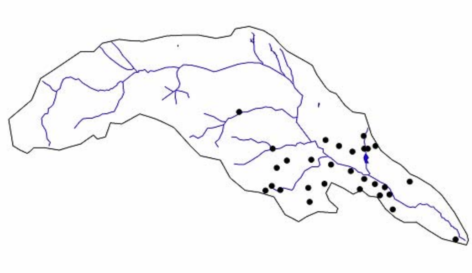

Fig. 14 – Distribution of *Hyla arborea*

<u>*Pelophylax lessonae*</u> Camerano 1878

The pool frog is a frog species that has been previously identified in Romania in very few localities (Cogălniceanu et al, 2000). We recorded this species in only 8 localities from our research area. We found this species living either by its self, or coexisting with *Pelophylax kl. esculentus* or *Pelophylax ridibundus* or both, forming the R-E-L system (Tunner & Heppich-Tunner 1991), which is also fairly common in western Romania (Covaciu-Marcov et al 2004, 2006). In the research area, this species was found in small ponds, slow shallow rivers and even in temporary puddles, road-side ditches and irrigation canals.

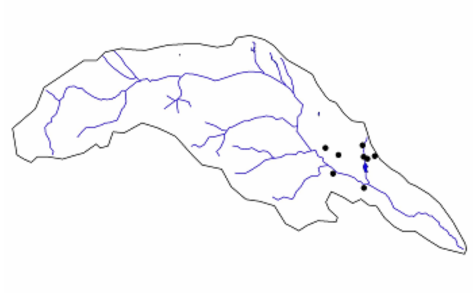

Fig. 15 – Distribution of *Pelophylax lessonae*

Pelophylax kl. esculentus Linnaeus 1758

The edible frog has a hybrid origin from *Pelophylax ridibundus* and *Pelophylax lessonae* (Cogălniceanu et al, 2000). It was recorded by us in 17 investigate localities in the Suceva river basin.

Fig. 16 – Distribution of *Pelophylax kl. esculentus*

Pelophylax ridibundus Pallas 1771

The lake frog is a very common species in the area, being identified by us in 25 localities from the Suceava river basin.

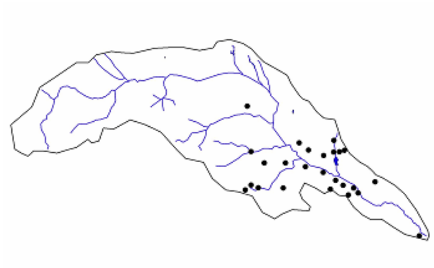

Fig. 17 – Distribution of *Pelophylax ridibundus*

Rana temporaria Linnaeus 1758

The common frog is the most common frog species from our research area, being recorded in 34 localities. This species was found in every investigated forest and even alongside the main river flows from the area, at low altitudes.

Fig. 18 – Distribution of *Rana temporaria*

Rana arvalis Nillson 1842

The moor frog is an extremely rare species in the research area, being identified by us in just 4 localities. In the studied region, the moor frogs were observed in marshlands and small swamps situated in open areas near a permanent source of water, similar to the habitats described for moor frog populations from north-western Romania (Sas et al, 2006).

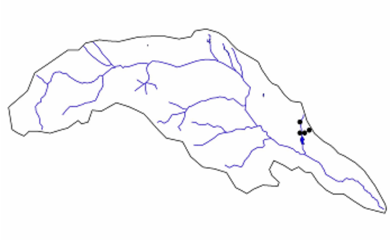

Fig. 19 – Distribution of *Rana arvalis*

Rana dalmatina Bonaparte 1840

The agile frog is a relatively common species in the area, being recorded in 12 localities. It was always found in or near deciduous forests.

Fig. 20 – Distribution of *Rana dalmatina*

Reptilia Linnaeus 1758:

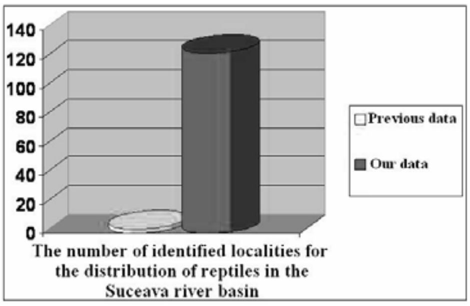

Fig. 21 – The number of previously known and personally identified localities for the distribution of reptiles in the area

Emys orbicularis Linnaeus 1758

The pond terrapin is a very rare and endangered species in the investigated area, being found by us in only 5 localities.

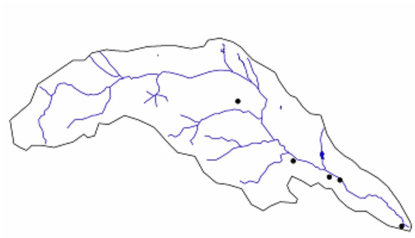

Fig. 22 – Distribution of *Emys orbicularis*

Tab. 1 – The distribution of the herpetofauna in the Suceava river basin:

Species **Locality**	S s	M a	T c	L m	L v	B b	B v	B x	P f	Bf b	Pv v	H a	P l	P e	P r	R a	R d	R t	E o	A f	Z v	L a	N n	C a	Z l	V b
Arbore	-	-	-	-	-	-	X	-	-	X	-	X	-	-	X	-	-	X	-	X	X	X	X	-	-	-
Bălăceana	-	-	-	-	X	X	X	X	-	X	X	X	-	X	X	-	X	X	-	-	X	X	X	-	-	-
Bosanci	-	-	-	-	-	S2		-	-	-	S2	S2	-	-	-	-	-	S2	-	-	X	S1	S1	-	-	-
Botoşana	-	-	-	-	-	-	X	-	-	X	-	X	-	-	-	-	-	X	-	X	X	X	X	-	-	-
Cacica	S	-	S	O	S	O	S2	-	-	S	O	S	-	S	S2	-	O	S	-	S1	S1	S1	S1	-	S1	S1
Cajvana	-	-	-	-	-	-	X	-	-	X	X	X	-	-	X	-	-	X	-	X	X	X	X	-	-	-
Costâna	-	-	S2	-	S2	S2	S2	S2	-	S2	S2	S2	S2	S2	S2	-	-	S2	X	X	-	X	X	-	-	-
Dărmăneşti	-	-	S2	-	S2	S2	S2	S2	S2	-	S2	S2	S2	S2	S2	-	S2	S2	-	S1	-	S1	S1	S1	S1	-
Dragomirna	-	-	S2	-	S2	S2		-	-	S2	-	S2	S2	S2	S2	S2	S2	S2	-	S1	S1	S1	S1	-	S1	-
Gura Putnei	X	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	X
Dănila	-	-	X	-	X	X	X	X	X	-	X	X	X	X	X	-	X	X	-	-	-	X	X	-	-	-
Ilişeşti	S2	-	S2	-	S2	-	S2	-	-	S2	-	S2	-	-	-	-	-	S2	-	-	-	S1	S1	-	-	-
Ipoteşti	-	-	-	-	-	X	-	-	-	X	X	X	-	X	X	-	-	X	-	-	-	S1	-	-	-	-
Lipoveni	-	-	S2	-	S2	S2		-	-	S2	-	S2	S2	S2	S2	S2	S2	S2	-	-	-	X	X	-	-	-
Lisaura	-	-	-	-	X	X	-	-	-	-	X	X	-	-	X	-	-	X	X	-	X	X	X	-	-	-
Liteni	-	-	-	-	-	-	X	-	-	X	X	X	-	-	X	-	-	X	S1	-	-	S1	S1	-	-	-
Marginea	S2	-	S2	-	S2	-		-	-	S2	-	S2	-	-	-	-	S2	-	-	X	X	X	X	X	-	-
Mihoveni	-	-	-	-	-	-	X	-	-	X	-	X	-	-	X	-	-	X	-	-	-	X	X	-	-	-
Mitocaşi	-	-	S2	-	S2	S2		-	-	S2	-	S2	S2	S2	S2	S2	S2	S2	-	X	-	X	X	-	-	-
Mitocul Dragomirnei	-	-	S2	-	S2	S2		-	-	S2	-	S2	S2	S2	S2	S2	S2	S2	-	X	-	X	X	-	-	-
Pârteştii de jos	S2	-	S2	-	S2	-	S2	-	-	S2	-	S2	-	S2	S2	-	-	S2	-	S1	S1	S1	S1	-	-	S1
Pârteştii de sus	X	-	S2	-	S2	-	S2	-	-	X	-	S2	-	S2	S2	-	-	S2	-	S1	S1	S1	S1	-	S1	S1
Pătrăuți	-	-	X	-	X	X	X	X	-	-	X	X	-	X	X	-	X	X	-	-	-	S1	S1	-	-	-
Poieni-Solca	X	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	-
Putna	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	X
Rădăuți	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X	S	-	-	X	X	-	-	-
Salcea	-	-	-	-	X	X	-	-	-	-	X	X	-	-	X	-	-	X	-	-	-	S1	S1	-	-	-
Satu Mare	-	-	S2	S2	-	-	S2	-	-	-	-	-	-	-	-	-	S2	S2	-	-	X	X	X	-	-	-
Şcheia	-	-	S2	-	S2	S2	S2	S2	-	S2	S2	S2	X	S2	S2	-	-	S2	-	-	-	S1	S1	-	-	-
Sfântu Ilie	-	-	X	-	X	X	X	X	-	X	X	X	-	X	X	-	-	X	-	-	-	X	X	-	-	-
Suceava	-	-	S2	-	S2	S2	S2	S2	O	S2	S2	S2	-	S2	S2	-	S2	S	S	X	X	S	S1	-	-	-
Sucevița	X	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	X
Tişăuți	-	-	-	-	X	X	-	-	-	-	X	X	-	-	X	-	-	X	-	-	X	X	X	-	-	-
Todireşti	-	-	X	-	X	X	X	-	-	-	X	X	-	X	X	-	X	X	-	X	-	X	X	-	-	-
Vâlcele	-	-	-	-	S2	S2	S2	-	-	S2	S2	S2	-	-	-	-	-	S2	-	-	X	X	X	-	-	-
Voitinel	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	-
Total number of localities	9	2	18	4	22	19	25	8	2	24	17	29	8	17	25	4	12	34	5	19	20	36	35	2	4	6

Legend:

X – new localities for the Romanian herpetofauna
S1 – data from Strugariu et al 2006 a.
S2 – data from Strugariu et al 2006 b.
S – localities in which we reconfirmed the presence of the species
O – localities in which we could not reconfirm the presence of the species

Ss = *Salamandra salamandra*, Ma = *Mesotriton alpestris*, Tc = *Triturus cristatus*, Lm = *Lissotriton montandoni,* Lv = *Lissotriton vulgaris*, Bb = *Bombina bombina*, Bv = *Bombina variegata*, Bx = *Bombina bombina* X *Bombina variegata*, Pf = *Pelobates fuscus*, Bf b = *Bufo bufo*, P v = *Pseudepidalea viridis*, Ha = *Hyla arborea*, Pll = *Pelophylax lessonae,* Pe = *Pelophylax kl. esculentus*, Pr = *Pelophylax ridibundus*, Ra = *Rana arvalis*, Rd = *Rana dalmatina*, Rt = *Rana temporaria*, Eo = *Emys orbicularis*, Af = *Anguis fragilis*, Zv = *Zootoca vivipara*, La = *Lacerta agilis*, Nn = *Natrix natrix*, Ca = *Coronella austriaca*, Zl = *Zamenis longissimus*, Vb = *Vipera berus*.

Anguis fragilis Nordmann 1840

The slow-worm is a wide-spread and common reptile species in the area, being mostly encountered in or near forested regions, in moister microhabitats. Several specimens were found killed on roads.

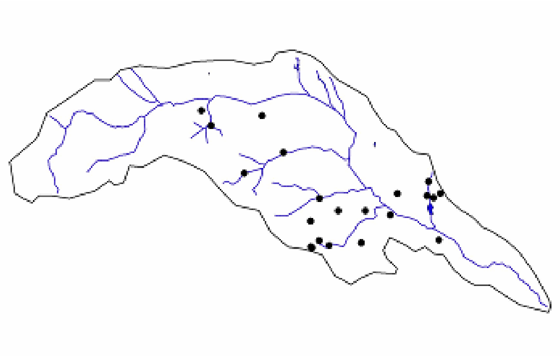

Fig. 23 – Distribution of *Anguis fragilis*

Zootoca vivipara Jacquin 1787

The viviparous lizard is a common species in the studied area. Up until recently it was thought to be an exclusively mountain species (Fuhn and Vancea, 1961). Recent studies (Ghira et al 2002, Covaciu-Marcov et al 2002, 2004, 2005) have identified this species existing in lowland areas from the western plains as well as in lowland areas from North-eastern Romania (Covaciu Marcov et al, 2003a, Strugariu et al 2006a). The results of the present study indicate that the viviparous lizard is considerable more wide spread and common in the lower areas from north-eastern Romania than previously considered (Strugariu et al 2006a). Whilst in the mountain regions this species is usually found near forested areas, the lowland populations have always been found in open areas with a high humidity level which area situated near a permanent source of water.

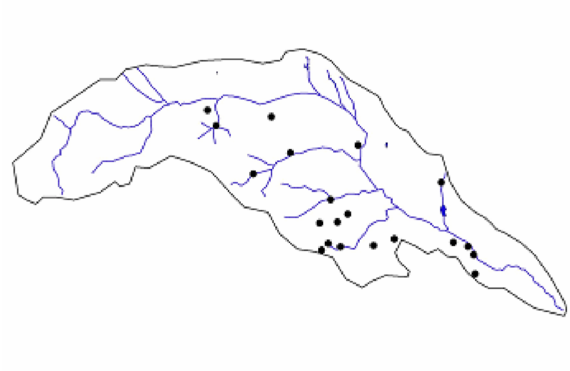

Fig. 24 – Distribution of *Zootoca vivipara*

Img. 1 – Habitat with *Zootoca vivipara* and *Rana temporaria*, near Suceava (photo by Al. Strugariu)

Img. 2 – *Zootoca vivipara* from near Suceava (photo by Al. Strugariu)

Lacerta agilis Linnaeus 1758

The sand lizard is the most common reptile species from the area, being identified by us in every investigated locality.

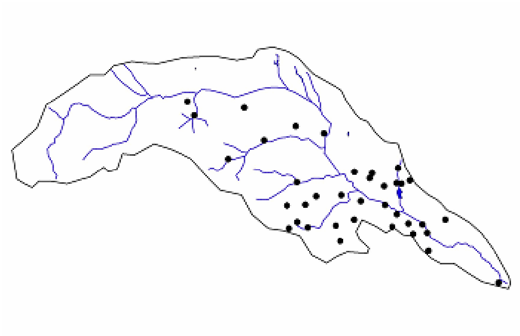

Fig. 25 – Distribution of *Lacerta agilis*

Natrix natrix Linnaeus 1758

The grass snake is a very common species in the area. It was identified by us in 35 localities, mostly near a water source or in humid forests.

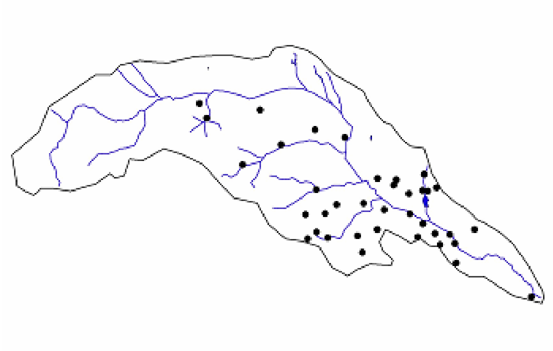

Fig. 26 – Distribution of *Natrix natrix*

Coronella austriaca Laurentus 1768

The smooth snake is an extremely rare species in the area, being recorded by us in only 2 localities from the Suceava river basin. In both cases, the smooth snakes were found in scrub filled deciduous forest margins.

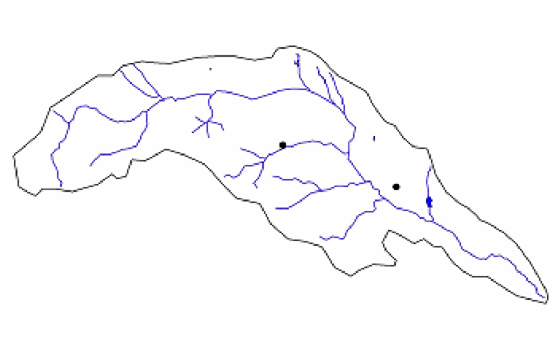

Fig. 27 – Distribution of *Coronella austriaca*

Zamenis longissimus Laurentus 1768

The aesculapian rat snake is the only semi-arboreal snake species from Romania (Fuhn, 1969). This is also a very rare species in the research area, being recorded in only 4 localities. The snakes were only found in or near deciduous forests.

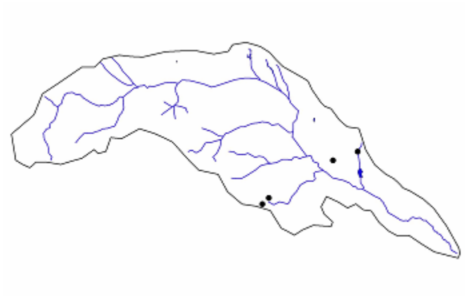

Fig. 28 – Distribution of *Zamenis longissimus*

Vipera berus Linnaeus 1758

Due to the fact that few localities from the Suceava river basin are situated at higher altitudes, the adder is a rare species in the area, being an almost exclusively mountain species (Fuhn & Vancea, 1961). We have recorded this species in only 6 localities, all of them situated at higher altitudes. The adders were found in rocky slops situated near mixed forests.

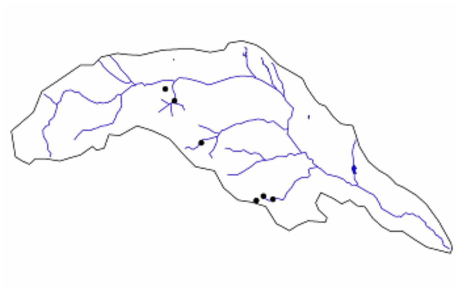

Fig. 29 – Distribution of *Vipera berus*

Conclusions

During our research in the Suceava river basin we have identified 16 species of amphibians (*Mesotriton alpestris, Triturus cristatus, Lissotriton montandoni, Lissotriton vulgaris, Bombina bombina, Bombina variegata, Pelobates fuscus, Bufo bufo, Peseudepidalea viridis, Hyla arborea, Rana arvalis, Rana dalmatina, Rana temporaria, Pelophylax lessonae & Pelopxylax ridibundus*) and 8 species of reptiles (*Emys orbicularis, Anguis fragilis, Zootoca vivipara, Lacerta agilis, Natrix natrix, Coronella austriaca, Zamenis longissimus and Vipera berus*). We have also observed hybrids between *Bombina bombina* and *Bombina variegata* and between *Pelophylax ridibundus* and *Pelophylax lessonae* (*Pelophylax kl. esculentus*). Of these, *Mesotriton alpestris* is a premier for the herpetofauna of the investigated area.

We have identified 376 localities for the distribution of the herpetofauna in the 36 investigated geographical localities.

Rana temporaria, a species that is usually linked to higher altitudes in Romania has been found by us at lower altitudes, alongside the main water flows. This, along with the presence of *Rana* *arvalis*, a glacial relict in Romania, is explained by the more colder and moister climate of the region compared to other regions of the country.

Bombina bombina and the hybrids between this species and *Bombina variegata* are situated in the area at their superior altitude limit in Romania.

The Suceava river basin is home to all 3 forms of the *"Pelophylax esculentus"* complex. Identifying more *Pelophylax lessonae* populations in the area is very important due to the fact that very few localities are known for this species' distribution in the whole of Moldavia.

Zootoca vivipara, a species that has been considered a strictly mountain species until recently has been found to be very common and wide-spread in the lowland localities from the Suceava river basin.

Zamenis longissimus and *Coronella austriaca* are the most threatened species from our research area, being under constant stress caused by human activities, especially forest clearing.

Rezumat

Scopul acestui studiu a fost realizarea unei sinteze a cunoştinţelor privind compoziţia şi răspândirea geografice a herpetofaunei din bazinul hidrografic al râului Suceava (din judeţul Suceava, România). În urma cercetărilor am identificat 16 specii de amfibieni (*Salamandra salamandra, Mesotriton alpestris, Triturus cristatus, Lissotriton montandoni, Lissotriton vulgaris, Bombina bombina, Bombina variegata, Pelobates fuscus, Bufo bufo, Pseudepidalea viridis, Hyla arborea, Rana arvalis, Rana dalmatina, Rana temporaria, Pelophylax lessonae & Pelophylax ridibundus*) şi 8 specii de reptile (*Emys orbicularis, Zootoca vivipara, Anguis fragilis, Lacerta agilis, Natrix natrix, Coronella austriaca, Zamenis longissimus şi Vipera berus*) pe teritoriul zonei investigate. Pe lângă acestea, am identificat hibrizi între *Bombina bombina* şi *Bombina variegata* precum şi între *Pelophylax ridibundus* şi *Pelophylax lessonae* (*Pelophylax kl. esculentus*). În total, am identificat 376 de localităţi pentru herpetofauna României în cele 36 de localităţi geografice studiate. Cele mai signifiante rezultate ale acestui studiu constau în descoperirea numeroaselor populaţii de *Zootoca vivipara* şi *Rana temporaria* situate la altitudini joase şi a populaţiilor de *Bombina bombina* situate la altitudini mai mari decât în alte zone ale ţării. De asemenea, *Mesotriton alpestris* a fost identificat in premieră pentru regiunea investigată.

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References

1. BERGER L., 1966 - *Biometrical studies on the population of water frog from the environs of Poznan*. Ann. Zool. 23, 303 – 324.
2. BERGER L., 1973 - *Systematics and hybridization in European green frogs of Rana esculenta Complex.* J. Herpetol. 7, 1 – 10.
3. BOTNARIUC M., 1980- *Judeţele Patriei-Suceava*. Ed. Sport-Turism, Iaşi.
4. COGALNICEANU, D. 1991. *A preliminary report on the geographical distribution of amphibians in Romania.* Rev.Roum. Biol-Biol. Anim. Tome 36, 1-2. pp: 39-50.
5. COGALNICEANU, D. 1997 - *Amphibian ecology practicum – methods and techniques in the study of amphibian ecology*. Ed. Universităţii din Bucureşti, 1 – 122. (in Romanian)
6. COGALNICEANU D., AIOANEI F., BOGDAN M. 2000 - *Amphibians from Romania. Determination keys*. Ed. Ars Docendi, Bucureşti, 1 – 99. (in Romanian)
7. COVACIU - MARCOV S. D., GHIRA I., VENCZEL M., 2000 - *Contributions for the study of the herpethofauna of Oradea*. Nymphaea, Folia Naturae Bihariae, Oradea XXVIII, 143 – 158. (in Romanian, with English abstract)
8. COVACIU - MARCOV S. D., TELCEAN I., CUPSA D., CADLET D., ZSURKA R., 2002. *Contributions to the study of the herpethofauna from Marghita (Bihor County, Romania).* Analele Univ. din Oradea, Fasc. Biol., Tom IX, 2002, 47 – 58. (in Romanian, with English abstract)
9. COVACIU–MARCOV S.D., SAS I., CICORT-LUCACIU Al., KOVACS E.H., 2003a – *Notes upon the herpetofauna of the Northern area of Botosani County(Romania)*, Studii şi Cercetări Biologie 8, Universitatea din Bacău Noiembrie: 201-205.
10. COVACIU - MARCOV S. D., SAS I., CUPSA D., MELEG G., BUD B., 2003b - *Herpethological studies in the Padurea Craiului and Plopişului Mountains region*. Analele Univ. din

Oradea, Fasc. Biol., Tom X, 81 – 95. (in Romanian, with English abstract)
11. COVACIU - MARCOV S. D., CUPSA D., TELCEAN I., SAS I., A. CICORT, 2003c - *Contributions to the study of the herpethofauna from the middle and inferior course of the Crişul Negru River (Bihor County, Romania).* Oltenia, Studii şi Comunicări, Ştiinţele Naturii, Vol. XIX, 189 – 194. (in Romanian, with English abstract)
12. COVACIU - MARCOV S. D., GHIRA I., SAS I., 2004. *Contributions to the study of the herpethofauna from Oaş region (Satu – Mare County, Romania).* Mediul cercetare, protecţie şi gestiune, 2, Cluj –Napoca, 107 – 112. (in Romanian, with English abstract)
13. COVACIU - MARCOV S. D., CICORT - LUCACIU A. Şt., SAS I., BEDET A. M., BOGDAN H., 2005. *Herpetofauna from the basin of Mureş river in Arad county, Romania*. Mediul cercetare, protecţie şi gestiune, 5, Cluj –Napoca, 147 – 152.
14. COVACIU-MARCOVE S.D., SAS.I, KISS A. BOGDAN H., CICORT-LUCACIU A.Ş. 2006, *The herpetofauna from the Teuz hidrographic basin (Arad County, Romania)*. North-Western Journal of Zoology, Vol. 2(1). Pp: 27-38
15. CSATA Z., 1998. *Serologic and morfologic study upon the types belonging to the Rana esculenta complex.* Acta, Muzeul Secuiesc, Sfântu Gheorghe, 111 – 140. (in Romanian, with English abstract)
16. FUHN I., 1960. *The fauna of the People's Republic of Romania*. *vol. XIV, fascicola I, Amphibia*. Editura Academiei R.P.R., Bucureşti, 1 – 288. (in Romanian)
17. FUHN I, VANCEA Şt., 1961 - *"Fauna R.P.R.", Vol. XIV, II Reptilia* – Ed. Academiei R.P.R.,Bucuresti.
18. FUHN I, 1969. *Broaşte, şerpi, şopârle*. Ed. Ştiinţifică, Bucureşti.
19. GHERGHEL I, ILE D 2006. *Contributions. to the distribution of Amphibia, Caudata in Neamţ County, Romania.* North-Western Journal of Zoology, 2. 1: 44-46
20. GHIRA I., MARA G., 2000. *Using the allelomorphic feature in identifying two species belonging to genus Bombina (Anura, Discoglossidae) from Transilvania*. Studia Univ. Babeş – Bolyai, Cluj – Napoca, XLV, 85 – 95.
21. GHIRA. I., VENCZELl M., COVACIU – MARCOV, S. D., MARA G., GHILE P., HARTEL T., TOROK Z., FARKAS L., RACZ T.,FARCAS Z., BRAD T, 2002 - *Mapping of Transylvanian Herpetofauna*. Nymphaea, Folia naturae Bihariae, Oradea XXIX.: 145-203. Oradea
22. GHIURCA D., ROSU S., GHERGHEL I., 2005. *Preliminary data concerning the herpetofauna in Neamţ County (Romania)*,Analele Univ. Oradea, Fasc. Biologie, Tom. XII, 53-62 pp.
23. IFTIME Al., 2005. *Amfibieni. Reptile. În: Cartea Roşie a Veretebratelor din România*, editori: Botnariuc & Tatole. Ed. Acad. Române, 1 – 325.
24. SAS, I., COVACIU-MARCOV, S.D., KOVACS, E.H., RADU, N.R., TOTH, A., POPA, A., 2006. *The populations of Rana arvalis Nills. 1842 from the Ier Valley (The Western Plain, Romania): present and future*, North-Western Journal of Zoology, Vol. 2 (1), pp.1-16
25. STUGREN B., 1980. *Geographical variation of the fire – bellied toad (Bombina bombina (L.)) in the USSR. (Amphibia, Anura, Discoglossidae)*. Zool. Abh. Mus. tierk. Dresden, 36 (5): 101 – 115.
26. STRUGARIU Al., SAHLEAN C.T., HUTULEAC - VOLOSCIUC M.V., Puşcaşu M.C.. 2006 a, *Preliminary data regarding the distribution of reptilian fauna in Suceava County (Romania).* North-Western Journal of Zoology, Vol.2 (1). Pp: 39-43
27. STRUGARIU Al, GHERGHEL I, HUTULEAC - VOLOSCIUC M.V., SAS I, SAHLEAN T.C., PUSCASU Cr. M, 2006 b. *Preliminary data concerning the distribution of amphibian fauna in Suceava County (Romania).* Anal. Univ. Oradea. Fasc. Biologie, TOM XIII, pp: 39-47
28. SZYMURA J. M., 1993. *Analysis of hybrid zones with Bombina. In Hibrid zones and the evolutionary process* (ed R. G. Harrison), pp 261 – 289. Oxford: Oxford University Press.
29. TUNNER H. G., HEPPICH – TUNNER S., 1991. *A new population system of the water frogs discovered in Hungary*. In Koros Z., Kiss I. (ed), Proc. Sixth. Ord. Gen. Met. S. H. E., 453 – 460, Budapest.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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ASPECTS REGARDING THE USE OF PHYSICAL ENVIRONMENT BY THE BIRD SPECIES IN THE BOTANICAL GARDEN "ANASTASIE FATU", IAŞI, ROMANIA

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CONSTANTIN ION*

ABSTRACT

BUTNARU (CROITORU) M. M., ION C-TIN, 2006 - Aspects regarding the use of physical environment by the bird species in the botanical garden "Anastasie Fatu", Iasi, Romania. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 447-449.

The paper includes a qualitative and quantitative inventory of the bird species from the Iasi "Anastasie Fatu" Botanical Garden realized during the November 2003 and September 2006 interval. We have calculated the dominance taking into account not only the number of individuals but also the kilometric index of abundance, the frequency, the biomass, the energetic loss surface. The goal was to observe if from a macroecological point of view this ecosystem can sustain the bird species (and the number of individuals through which these are represented).

Key words: avifauna, species, index, biomass, dominance

Introduction

The ornithological investigations were made in the Iasi "Anastasie Fatu" Botanical Garden from November 2003.

This garden has multiple functions (didactic, scientific, recreational-cultural, hygienico-sanitary and preservation of the spontaneous plants genetic fund) has a surface of 103, 80 ha. which represents 12,56 % of the total of green spaces of the Iasi city. The Botanical Garden is an important green space in the north side of the city with a fixating role for plantations on a fields predisposed to sliding, a protection role for the mineral water resources (presently exploited) and also a climatic protection role against unfavorable winds and excessive temperatures.

The Botanical Garden is an artificial ecosystem with a naturalization tendency in which the biotope (the soil conditions, microclimate) are systematically improving.

Material and method

The paper is based on the tracts method, modified and completed by Dan Stanescu. We have crossed a total of 32 transects covering all the sectors of the Botanical Garden. By the method described by dr. Dan Stanescu, the number of individuals for each species was noted at each observation. For the identified species the separation index was calculated (to find out the dominance degree) depending on the IKA (the kilometric index of abundance), frequency, biomass, energetic loss surface. All the values of these indexes were used as natural logarithms. Data from observations made across 16 tracts were used (aleatory selected). In order to analyze the repartion of physical space and ecological resources between species we have used the EcoSim 7.0 program.

Results and discussions

The species with the highest value of the separation index is *Sturnus vulgaris*. It is very well represented as number of individuals, while the weight and metabolic index have small values (80 g, respectively 18, 6 cm^3) *Sturnus vulgaris* is followed by A*nas platyrhynchos,* species which is not as greatly represented as a number of individuals, but the biomass (1200 g) and metabolic index (112.9 cm^3) have the highest values of all the species from the Botanical Garden. High values of the separation index reach also the species of turdidae (*Turdus merula, Turdus philomelos*) and corvidae (*Garrulus glandarius*, *Pica pica, Corvus frugileggus)*. These are well represented as number of individuals, and the biomass and metabolic index are high.

The lowest values of the separation index have the paseriforme species (*Phoenicurus ochruros, Erithacus rubecula, Emberiza calandra, Alauda arvensis, Sylvia communis, Acrocephalus*

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palustris), which have low biomass and metabolic index. Low values of separation have also the species with gross sizes (*Turdus iliacus, Upupa epops, Nycticorax nycticorax)*, but they were rarely met during the tracts crossing.

In continuation, we have used the Size Overlap model from the Ecosim 7.0. program, in order to accentuate the importance of biomass for the coexisting of the bird species from the same ecosystem.

The obtained variance value taking into account the biomass of each species represents the minimal distance allowing the coexisting of species. The species which are "too similar" regarding the biomass can be incapable of coexisting due to sharing of ecological resources. Thus, we have compared the obtained model to the theoretical one, in which the populations are not structured on competition basis.

Observed index = 0.27013
Mean of simulated index = 0.30073
Variance of simulated index = 0.06312
p (observed >= expected) = 0.39100
p (observed <= expected) = 0.60900

So, from the obtained results we can notice that the species are very similar concerning the energetic needs and they cam compete for the use of trophic resources.

The number of species and individuals is relatively large with excellent feeding conditions and low anthropic impact, especially during week days. However, the surface of the garden is small in our opinion, and towards the eastern and southern limits, the human phonic pollution, house building, tree cutting are increasing.

On the other hand, the competition for the physical space is not too accentuated and according to statistics, the difference between the theoretical index and the one from our observations in not very large. Thus we can say that the diversity of habitats is large enough in order to sustain a relatively high diversity of the avifauna. Therefore, we have realized a complementary mecroecological test to find out the level of competition between bird species for food resources.

In the macroecological analysis we have referred to the sharing of physical space sharing and ecological resources. Therefore, we have taken into account the logarithmic values of the kilometric index of abundance and biomass for each species. For the macroecological test we have based on the premises that the analyzed species are non-independent and enter the competition for the physical space and ecological resources.

According to calculations:

(Observed dispersion = 90.75000
Mean of simulated dispersions = 8.49592
Variance of simulated dispersions = 18.85318
Number of times observed dispersion < simulated dispersions = 0
Number of times observed dispersion = simulated dispersions = 0
Number of times observed dispersion > simulated dispersions = 1000
Standardized Effect Size = 18.94372
p (observed <= expected) = 1.00000
p (observed >= expected) = 0.00000)
results that the investigated species, due to the relatively large number of individuals, enter an obvious competition for nesting space and food. This results in the dominance of ducks in the lake area, of corvidae, turdidae and wood-peckers in the wood areas and on the meadows we noticed subdominant species of passeriforme.

Conclusions

In addition to other anterior avifaunistic studies realized in the Botanical Garden based only on the study of species and number of individuals, this paper proves that the Botanical Garden, although hosting a large diversity of habitats and rich trophic resources, cannot sustain a large number of species due to gross size species' dominance around the lake area and wood areas, and also the high number of passeriforme in the meadows' areas.

Rezumat

Lucrarea cuprinde o inventariere calitativa si cantitativa a speciilor de pasari din Gradina Botanica "Anastasie Fatu" din Iasi, realizata in intervalul noiembrie 2003-septembrie 2006. Am calculat dominanta pentru fiecare specie, tinand cont nu doar de numarul de indivizi, ci si de indicele kilometric de abundenta, frecventa, biomasa, suprafata pierderii energetice. Scopul a fost de a vedea din punct de vedere macroecologic, daca acest ecosistem poate sustine speciile de pasari (si numarul de indivizi prin care acestea sunt reprezentate).

References

1. BRUUN B., DELIN H., SVENSSON L.,1999 – *Păsările din România şi din Europa (determinator ilustrat)*, versiunea românească D. Munteanu, Ed. Hamlyn, London.
2. MULLARNEY K., SVENSSON L., ZEETERSTROM D., GRANT P.J., 2004 – *Le guide ornitho.* Delachux et Niestle, Paris, 400.
3. STANESCU D., 1999 – *Contributions to the knowledge of the erratic hyemal flocks of Passeriformes from the Quercus in the western Romania.* Annals of West University of Timisoara, Series of Biology, vol. II, 26.

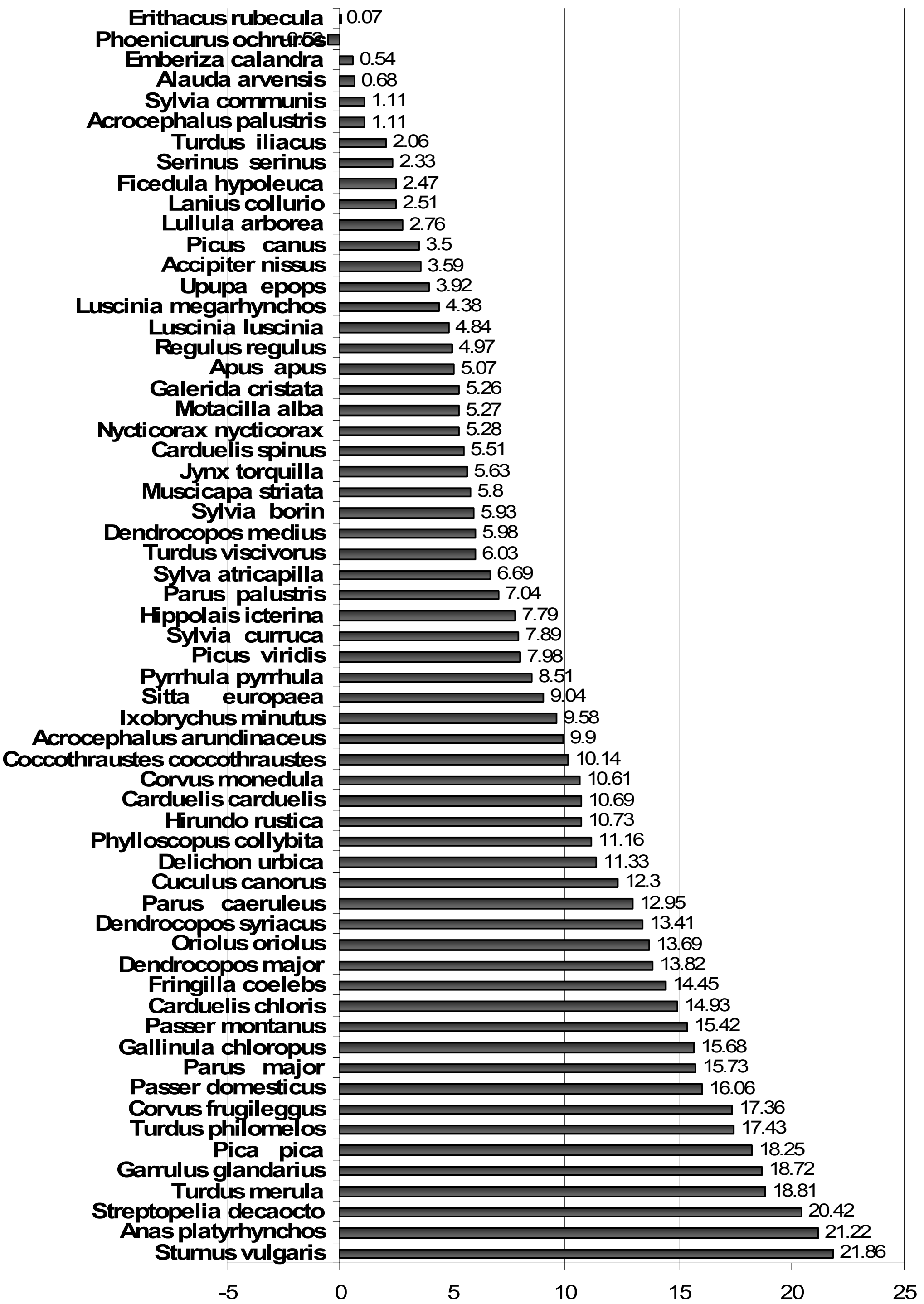

Fig. 1 The values of separation indeces for the bird species in Botanical Garden

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THE ECOLOGY AND JURIDICAL PROTECTION OF THE MOUNTAIN ROOSTER *(TETRAO UROGALLUS)*

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ABSTRACT

MUREŞAN D., CEUCA D., ZSOLT K., 2006 - The ecology and juridical protection of the mountain rooster *(Tetrao urogallus)*. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 450-456.

Considering the geographic distribution of the species *Teatro urogallus* (mountain cock), we can say that it is encompassed between the north-west of Spain, central Siberia and north-east of Mongolia, including 12 species. The phenotypic features are those of a sedentary mountain bird.

The legislation in force does not particularly point to this bird. Certain elements of it can though be applied in order to offer an efficient and long term protection to the species.

Key words: mountain rooster, the protection, cynegetic found

Introduction

Within this paper I want to present a few habitual and ecologic aspects of the species *Tetrao urogallus* (mountain cock) as well as mandatory steps for the protection of the species before it comes to suffer an important decline. The mountain rooster *(Tetrao urogallus)* belongs to the *Tetraonidae* family *(ord. Galiformes)* and is the biggest in size. The area on which this species spreads contains a large part of Eurasia, bordered between the North-West of Spain, passing through the Siberian taiga and till the North-East of Mongolia. On these territories, the species presents itself fragmented in twelve subspecies. Their names and the territories they populate, are given in the table bellow.

T. urogallus cantabricus **–** The North-West of Spain
T. urogallus aquitanicus – The Pyrinei
T. urogallus major – Central Europe (The Alpes and The Baltic States)
T. urogallus rudolfi – South-East Europe (Bulgaria and South-West Ukraine)
T. urogallus urogallus – Scandinavia, introduced in Scotland (1837)
T. urogallus karelius – Finland and Carelia
T. urogallus lonnbergi – The Kola Peninsula
T. urogallus pleskei – Bielorussia, Russia and Central Europe
T. urogallus obsoletus – Russia and North Europe
T. urogallus volgensis – Russia and South Europe
T. urogallus uralensis – The Urali, Occidental Siberia
T. urogallus taczanowski – Central Siberia and The North-East of Mongolia

The territorial repartition of the mountain rooster in Romania is relative diferentely expressed in the consulted bibliographical sources. In general, *Tetrao urogallus* is frequently located in the whole Carpathian chain, populating mixed forests, conifer forests and bilberry bushes. After "Ciochia", the uncertainty points in what concerns the populated territories, are situated in the North-East of

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Maramures, in the area of the Apuseni Mountains and the internal region of the Curved Carpathians. In "The Nesting Birds of Romania Atlas", the information regarding the unsure situation of the populated areas head to the North-West of Suceava County, the internal part of the Curved Carpathians and the Apuseni Mountains area, mentioned in the previous source. Being a sedentary species, its presence is remarked all year round.

The mountain rooster is one of the biggest land birds in our country, being adapted for the cold climate. In our region, in different areas, it `s also natively called "gotac mare". The territory of the mountain rooster is called "lek'.

The mountain rooster has similar dimensions to those of a goose, weighing from 3,5 up to 5 kg.

Its body has a dark colour and seems black from a far. It presents an accentuated sexual diformism and dicromism. The dicromism is given by the look of the shiny-black plumage with metallic irisations in the case of males and the variegated rusty red with white face of the females. Ther`s also a sexual dimorfism in what concerns the size of the body: males (100cm) and females (70cm).

The male has a black head with a supraciliar bald spot of an intense red or has red plumage all around the eyes. The beeck, that becomes stronger with age, gets also more rounded and similar to that of birds of pray.

As a general aspect, the black coloration with metallic reflexes prevails, while the hatchlings are black with white spots on every feather.

The tail is composed of 16-18 big feathers, doubled underneath, taking the form of a fan when opened. Also, the way of opening the fan of the tail and its length, proportional to the size of the body, places the specimen in a specific age category.

On its whole length, the torso presents feathers that grow all the way to its toes and keep the bird from sinking in the snow (varzobi).

The females have smaller dimensions , weighing in about 1,8-2,5 kg. They have a dark red-chestnut, almost rusty colour, covered in black spots. They have big light-brown spots on their chests. These features help them achieve a cromatik camouflage, especially in the nesting period and hile tending for their hatchlings. Their legs have no spurs and are partly or totally covered in feathers. Also we mustn `t forget to mention that they present scales on their feet and the supraciliar spot on their face is much reduced in comparison with the males.

Their movement occures on the ground or in the air, when a threat is sensed.

As a preferred habitat, the mountain rooster populates resin forests like the wide spread spruce fir forests on hills and mountains, reaching the altitude of the alpine gap, but is also spotted at the superior boundary of the mixed forests in the whole mountain chain.

The food it consumes is relatively different with every season. In summer it feeds on forest fruit, beans, seeds and even insects and other invertebrates, asurring the necessarry animal protein it needs.

In autumn, its diet is completed with mountain poplar tree leaves and in winter, besides birch tree buds, its seeks con needles beneath the snow.

It`s a sedentary species (that doesn`t migrate in winter) but only migrates shortly in search of better feeding grounds.

The nest is installed directly on the ground, made primitively, only from a few branches and leaves placed in a small depression in the ground, very well camouflaged.

The nesting takes place starting from the half of the month of May and consists of 7-10 eggs with a brown-rusty colour with small grey-yellow spots. The hatching takes about 23-25 days and is insured only by the female.

After hatching, the hatchlings are able to run and follow their mother through the tall grass, in search of food. They grow up very fast and after barely a week from hatching, they try their first jumps to flight, and by the time they are 30 days old, they are already flyers. By the time they are 42 day of age, they sleep up in trees.

Material and methods

In order to demonstrate how necessary new legislative chapters with regard to the protection and conservation of this species are, we selected the legislation regarding the protection of the mountain cock (*Tetrao urogallus*) and proposed adequate amendments (lege ferendo) after we studied the entire material.

Results and discussions

International Juridical Settlements

Starting with the half of the XX th century, the protection and the improvement of the enviromental conditions have become the main objective for all humanity. Numerous meetings have taken place between governments and within the governments and have tried to adopt programs designed to protect species and their habitats.

The specialists realized that the only way to protect the endangered species is the preservation of their ecosystems.

Therefore, an important step was the convention in Berna, on the !9th September 1979, regarding the preservation of the wild life and natural habitats in Europe. The European Council's member states have stated that "the wild flora and fauna are a natural patrimony of a great aesthetic, scientific, cultural, recreative, economic and intrinsic value tahat has to be protect and passed on the future generations.

They have also recognized the essential role which the wild flora and fauna have in maintaining the ecological balance.

Another important step was the Convention on Biodiversity adopted by the U.N.O.: Conference on Environment and Development in Rio de Janeiro in 1992. During this convention, methods of preserving the biodiversity both "in situ" (the preservation of the habitats) and "ex situ" (the preservation of the constituent elements), as well as the development of several programs, strategies and national and international plans have been discussed. The long term use of its elements, as well as the adoption of certain measures that could ensure the ecological reconstruction and the generation of the endangered species have been emphasized. Urgent measures must be taken regarding the species on "red list", as well as regarding the endangered species, but also the species which habits have been drastically reduced lately. There also have been adopted measures regarding the rebuilding of the involved population.

Internal/National Juridical Settlements

The XXth century represent an important step for Romania in terms of juridical protection of the environment, as the authorities' attitude, regarding the protection of certain species as well as of certain important areas from the scientific and economic point of view, has changed.

Thus on the 4th of July 1930 the first law for the protection of nature's monuments was promulgated.

Romania has subscribed to many international conventions regarding the juridical protection of the wild animals, ratifying them through the following laws: The Convention for the Preservation of Wild Life and Natural Habitats in Europe, Berna 1979 through/ by Law no. 13/1993; The Convention for the International Commerce of Wild Species amongst the endangered species, Washington, 1973 through/ by Law no.69/1994 and The Convention Regarding Biodiversity, Rio de Janeiro, 1992, through/ by Law no.58/1994.

Current Settlements Regarding the Protection of the Mountain Rooster in Romania

Law no.13/1993 notifying the Convention of Berna, 1979, acknowledges that the wild flora and fauna are a natural patrimony of a great aesthetic, scientific, cultural, recreative, economic and intrinsic value that must be protected and passed on to the future generations. They also play an essential part in maintaining the ecological balance. An important element is represented by the understanding of the of the necessity of preserving the flora and fauna species "in situ".

The 3rd article shows the necessary measures to be taken for the preservation of the wild species diversity by the implementation of the national policies of the preservation of the biodiversity by protecting the vulnerable species (especially endemically) and the endangered habitats, by fighting against pollution and by stimulating the process of ecological education and the circulation of the information.

The 3rd chapter (art. 5,6,7,8 and 9) refers to the preservation of the species.

The 6th article prohibits (for the fauna species mentioned in annex 3) any kind of (international) capture, any kind of leading into captivity and (international) killing, the (international) degradation or destruction of the breeding lands or resting areas as well as the (international) perturbation (especially during the breeding and hibernation seasons), the destruction or the (international) egg collecting or the internal trade of these animals, dead or alive, or of the products obtained from them.

Article no.8 stipulates that all means of capturing or killing these animals that are not selective will be prohibited along with any means of capturing or killing them that could lead to their extinction on an earth scale. The severe disturbance of these species' populations will also be prohibited.

Article no.9 stipulates that derogations of articles 4,5,6 and 7 or of article eight's interdiction to use certain means of capturing etc. these animals are possible provided that there is no other satisfactory solution and provided that they do not affect the survival of the involved populations. The derogations must not affect the flora and fauna's populations best interests. They allow the capturing, the leading into captivity or any other judicious exploitation of certain animals and wild plants in a restricted number and under strictly controlled circumstances. We can deduce that these derogations allowed by the law can occur in two exceptional circumstances: when there is no other satisfactory solution and "for research purposes, educational purposes or having as a purpose the repopulation as well as the growth of the population". There is a biannual report of the derogations that has to mention:

- the populations which are or have been the object of the derogation (if possible the number of the involved species);
- the authorized means of killing or capturing;
- the risk conditions, the time and place circumstances of the derogations;
- the authority in charge of declaring that these conditions have been fulfilled;

- the decisions referring to the means used and to the people involved.

The convention on Biodiversity adopted within the U.N.O. Conference Regarding the Environment and the Development, in Rio de Janeiro, 1992 ratified by Romania by Law no.58/1994 has the following objectives/aims:

- the preservation of the biological diversity;
- the long term use of its elements;
- the just and balanced division of the advantages which result from the exploitation of the genetical resources, especially from a satisfactory access to these resources and techniques and from being financed adequately.

The 6th article of this law stipulates general measures adopted by the signatory states, namely: the elaboration of strategies, plans or programs; the adoption of the existing ones along with the integration of the preservation and of the lasting use within plans, the programs and the sectorial or intersectorial pertinent policies.

The main preservation methods are:

a) the preservation "in situ", meaning the preservation of the ecosystems, implicitly of the habitats, and the maintenance or the rebuilding of the populations in their natural environment, where they have developed their distinctive characteristics, in time;

Article no.8 stipulates the following measures:

- establishing a system of protected areas or of zones where special measures of the preservation have to be taken into consideration;
- creating a proper management program for the different types of the protected areas;
- promoting a lasting development in the contiguous zones of the protected areas, in order to consolidate their protection

b) the preservation "ex situ" is in fact the preservation of the constituent elements of the specific and genetic diversity outside the ecosystems they are integrated in. The 9th article mentions:

- preserving the constituent elements of the biological diversity, especially in the countries they come from;
- establishing and maintaining the installations or preserving areas (genes banks, botanical gardens, zoological gardens and aquariums);
- adopting measures to ensure the ecological reconstruction and the endangered species regeneration bi reintroducing them in their natural habitats etc;

The Law for Environmental protection in Romania no.137/1995. In the first chapter "General Principles and Dispositions" there are two important aspects, namely the re-affirmation that the protection of the environment represents a 'major public objective" (art.1) as well as the fact that it is "an obligation of the central and local public administration as much as an obligation for all natural persons and legal person"(art.6).

The 3rd article stipulates the following principles and strategies:

- precaution in taking decisions
- preventing the ecological risks and preventing damage from being produced
- the preservation of the biodiversity and the ecosystems specific to the biogeographically frame of the country
- the polluter pays;
- setting up the national system of integrated controlling of the environment;
- the lasting use of the environment and resources;
- the maintenance, the improvement of the environment's quality and the ecological reconstruction of the deteriorated areas;
- giving the opportunity of the participating to the non-governmental organizations and to the population in elaborating and applying the decisions (taken)
- the development of the international cooperation in order to secure the quality of the environment

The 3rd chapter: The protection of the Natural Resources and the Preservation of Biodiversity, art.35 of the same law, mentions that the central public authority for the protection of the environment, together with the central public authorities in the field who administrate the natural resources elaborate technical reglementations, regarding measures for the protection of the ecosystems, for the preservation and durable use of the biological biodiversity's elements as well as for the security of man's health. The protected areas' policy, the preservation of the natural habitats, of the wild fauna and flora subject to the mentioned low a well as to the specific legislation in force.

The law of the Cynegetic Fund and of the Protection of the Game in Romania (no 3/1996) and the Law no.130 on the 12th of May 2006 regarding the approval of the Emergency Decree of the government no.193/2005 for the alteration and completion of article 36 (The Law of the Cynegetic Fund and of the protection of the Game no 103/1996) stipulates:

In the first chapter: "General Dispositions" it is mentioned that "the wild animals of hunting interest, listed in annexes I and II, together with their biotopes represent Romania's cynegetic fund".

According to article 7 the administration of the cynegetic fund of Romania is carried out by the central public authority in charge with the forestry (sylviculture).

Article 18 from chapter III also specifies that the hunting funds' managers have the obligation securing and protecting the game with the help of specialized staff and volunteer hunting inspectors.

Article 19 refers to the preservation of the biodiversity. Thus, for the purpose of preserving the biodiversity, hunting is allowed only within the limits of the approved harvesting quotation and it must subject to the technical reglementations regarding the organization and the practice of hunting.

Articles 20 and 21 refer to the preservation of the cynergetic fund of some sedentary species. Cynegetic reservations are made up for this purpose. Their surface has to be 4% minimum and 5% maximum from the national cynegetic fund's surface. Game stock farms are set up having as a direct6 or indirect purpose the growth of the effectives.

According to article 24, for the purpose of protecting the game the following are forbidden:

- populating the hunting funds with ill weakly, feeble, degenerated or from the stock farms destined exclusively for consumption game;
- the game species during the disturbing breeding period and during the bringing up of the offspring's period;
- building in captivity the wild animals as well as setting up game stock farms without being authorized by the authorities in charge;
- moving, destroying or taking away game's food;
- deteriorating wild birds' nests and collecting their eggs;
- taking hold of the game found dead; hurt or sick without the legal person's agreement;
- taking out of the country of the awarded or not awarded hunting toffees without having the approval of the competent authorities and without legal export documentation.

According to Article 26 hunting can be performed only by hunters who possess the hunting license annually endorsed and it is permitted only within the limits of the approved quotation and the technical reglementations regarding the organizations and practice of hunting. Still, hunting and capturing of some species from the cynegetic reservations, are allowed during the period in which hunting is normally prohibited if the responsible authorities authorize them with the (sole) purpose of improving or reducing their effectives.

Responsibilities and Sanctions

The juridical responsibility for the violation of the norms of the environmental rights differ from one another depending on how dangerous, from the social point of view, the did is. We distinguish two kinds of responsibility.

Hence, the contravention is defined as being a did for which the individual or legal person can be help responsible and be considered guilty but which represents a reduced social danger in comparison with the actual breaking of the law. Thus the contravention is punished accordingly. The contravention' s objects are the social values, the goods and the legitimate interests which are affected by the did. Consequently, the breaking of the law is a did for which the individual (or legal person) can be held responsible and be considered guilty of and which represents a greater social danger, it is stipulated by the law and punished accordingly. An essential element of the juridical responsibility regarding the wild animals' protection is that usually by violating the legal norms of the environmental laws the pollution of the environment is out of the question. Those who violate these norms and rights, pose a direct threat upon the life and health of the wild animals.

The Emergency decree no.195 on the 22nd of December 2005 Regarding the Protection of the Environment

In the chapter "The Preservation of the Biodiversity and Protected Natural Areas", article 49 (1) the Central Public Authority for the Protection of the Environment, together with other central public authorities, according to the necessities, elaborate technical reglementations regarding the measures for the protection of the ecosystems and for the biological diversity elements.

(2) The Protected Areas' Policy, the preservation of the natural habitats, the preservations of the wild flora and fauna subject to the present emergency decree as well as to the specific legislation in force.

The juridical responsibility and the way the sanctions regarding the protection of the wild animals and of their habitats are applied is rather inconsistent.

Article 96 (2) stipulates that the following violations of and they can be sanctioned with a fine from 10000 lei (RON) to 15000 lei (RON) for natural persons and with a fine from 35000 lei (RON) for legal persons: (1) the obligation of the natural persons and of the legal persons not to perform actions that could lead to the destroyer of the natural habitats and the destruction of the wild flora and fauna of the country.

The 6th Paragraph stipulates that any harvesting, capturing and/or buying and selling of the animals and plants from the wild flora and fauna, both terrestrial and aquatic, or of parts of them or products obtained from them, dead or alive, fresh or half-processed, on the internal market, by natural persons or legal persons unauthorized by the public territorial authorities in charge with the environment's protection, constitute contraventions, too.

The notion of "flora and fauna from all over the country" includes all species of wild animals protected by special laws, such as Law no.13/1993 which ratifies the Convention Regarding the Preservation of the Wild Life and of the Europe's Natural Habitats which contain the list of the protected species (in the annexes).

The violation of the dispositions of the present-day Law of the Cynegetic Fund and Protection of the Game (no.103/1996) completed and modified by (the) Law no.130/2006, which approves the Emergency Degree of the government no 193/2005 for the modification and completion of article no.36 from the Law of the Cynegetic Fund and Protection of the Game (no.103/1996):

The violation of these laws entail the disciplinary, contravention, civil or penal correction. According to art. 35 from the Law of the Cynegetic Fund the poaching is punished by detention from 2 to 3 years or with a fine between 5000-25000 lei (RON) per did:

- hunting without having a hunting license or any legal authorization;
- hunting animals whose hunting is forbidden;
- using prohibited methods of killing or capturing the animals (such as: electrical current, explosions; poisons etc);

According to article 36 the followings are considered breakings of the law:

- hunting the strictly protected game species without having the approval of the competent authority
- hunting in the national parks is severely punished (even the more attempt of hunting in these parks is punished);
- the exceeding of the harvest's quotation authorized.

The administration of the National Park (A.P.N.M.R.) is responsible for the management of the Rodnei Mountains National Park. The A.P.N.M.R. integrates within an unitary plan all activities and supervises them. It organizes specific activities ensuring an unitary management of the Park. The administration's headquarters is in Rodna. The activities organized by A.P.N.M.R., related to the preservation of the biodiversity are coordinated and approved by the P.N.M.R.'s Scientific Council.

In the certain reservations hunting as well as fishing are prohibited. For the hunting funds from Maramures, Bistrita si Suceava, which are constituted as genofund reservations, the stipulations of the Written Disposition no.949/1999 emitted by M.A.P.M.: (The Ministry of Waters, Forests and Protection of the Environment). These hunting funds will be administrated by all silvic offices (G.V.S.) as they cannot be rented. The illegal did in the hunting and fishing fields will be ascertained and sanctioned by the A.P.N.M.R.'s staff and by the silvic units staff in charge wish the Park zone (both A.P.N.M.R. and the silvic units being empowered to sanction them).

In order to achieve this goal, after taking an account of the species and after evaluating the peril probability, A.P.N.M.R. will ensure the continuous monitoring of the endemically elements, in peril or rare, as well as their characteristic habitats and the indicatory species.

Management reassures and Popositions

- modification of the hunting season (April-May) if the species remain on the annex's 1 list, because the hunting period superposes the mating, breeding and offspring's growth season. The period they are suggesting is between the 1st of September and the 20th of October.
- another suggestion is the transition of the species to annex 2 of the Cynegetic's Fund Law (hunting prohibited) with the other tertrahonides.
- prohibiting the bilberries' harvesting in the areas where there are mountain roosters and ceasing of the breaking up of the forests, especially the spruce fir forests, and not only of those which represent the so called "ecological corridors" for these species.
- creating stock farms mountain roosters, with the purpose of adjusting the effectives from the territories, so that it doesn't affect the trophic chains.
- achieving recording studies for the natural reservation's effective with the participation of the experts in the field and of the competent authorities

Conclusions

Following the studies and most of all the management measures and steps we proposed to be taken, the idea of new legislative articles is extremely clear in respect of the species' protection. This aspect is legitimated by the fact that with the *Tetrao tetrix* (birch cock) the legislation is very well established. It is a pity that it was done only after the species became considerably rare.

Rezumat

În ceea ce priveşte aspectul repartiţiei geografice speciei *Tetrao urogallus* (cocoşul-de munte), acesta este cuprins între nord-vestul Spaniei şi Siberia Centrală şi Nord-estul Mongoliei, incluzând 12 specii. Caracteristicile fenotipice sunt remarcate ca fiind specifice unei păsări sedentare de zonă montană.

Legislaţia în vigoare nu este adaptată în mod tipic acestei păsări, dar se pot extrage elemente care favorizează ocrotirea acesteia în aşa fel încât conservarea speciei să fie eficientă şi de durată.

References

1. BREHM R., 1994 - *Animals' World*. Imprimeria Bucuresti, p.521
2. GEORGESCU B., IOZON D., 2001 - *The Systematics and Ecology of Birds*. Presa Clujana, pp 96-97.
3. GUIDE H., 1991 - *The birds from Europe and Romania- Illustrated Determinator*. Hamlyn, p. 96.
4. CIOCHIA V., 1992 - *The Hatching birds from Romania-Atlas*. Ed. Stiintifica Bucuresti, pp 107- 108; p. 209.
5. *** The Romanian's Society for Ornithology Publications – *The Atlas of the Hatching Birds from Romania*, p 43.
6. *** Law no 13/1993 – *The Romania's Consent to he Convention Regarding the Preservation of the Wild Life end the natural habitats in Europe*. In Berna on the 19th September'1979
7. *** Law no 58/1994 – *For Ratifying the Convention on Biodiversity*. Rio de Janeiro, 1992
8. *** Law no 130/2006 - For the Modification and the Completion of article no 36 from the Law of the Cynegetic Fund and the Protection of the Game no. 103/1996
9. *** The Emergency Decree no 195 on 22nd December 2005 regarding the protect of the environment.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 457 – 459

DATA REGARDING THE IMPACT OF THE GREAT CORMORANT (*PHALACROCORAX CARBO SINENSIS*) UPON THE ICHTHYOFAUNA AND PISCICULTURE IN THE DANUBE DELTA

VIOREL CUZIC*

Abstract

CUZIC V., 2006 - Data regarding the impact of the great cormorant (*Phalacrocorax carbo sinensis*) upon the ichthyofauna andpisciculture in the Danube Delta. Studii şi Comunicări, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 457-459.

The numbers resulted from the estimations of the quantitative and economic impact cannot be used as reference data, these calculations (in the actual presentation) having the role of providing an overview of the impact of the Great Cormorant from the Danube Delta.

The lasting fish capture of the Danube Delta Biosphere Reserve is estimated at about **7,783 t** and the total quantity of fish consumed only by the Great Cormorant, besides the ichthyophagist birds, is about **6,816 t**. So, if we report this quantity to the estimated lasting fish capture, the result is that they consume 87.57 % of it.

From the estimation of the economic impact, the amount resulted is **26,786,500 RON** or 267,865,000,000 ROL or 7,440,694 Euros.

Many times, the biologists defended the ichthyophagist birds, underlining the facts that the great majority of the fish consumed by them has a trifling value and they represent an important selective and sanitary factor. Speaking about the Great Cormorant, these arguments don’t reflect the entire truth.

Key words: cormorant, impact, ichthyofauna, Danube Delta

Introduction

Even from the beginning of the present chapter, we note that when speaking about the Danube Delta, the reference is generic, considering the fact that the population of the Great Cormorant from the Danube Delta Biosphere Reserve cannot be treated separately for its physical-geographical units. The present study’s aim is to put into evidence the impact of the Great Cormorant upon the ichthyofauna of the Danube Delta Biosphere Reserve, by presenting data regarding its qualitative impact in the delta and by making estimations regarding the quantitative and economic impact upon the ichthyofauna and fish breeding in the Danube Delta Biosphere Reserve.

Material and method

The following calculation elements and their abbreviations were used for the estimations of the quantitative and economic impact upon the ichtyofauna and fish breeding in the Danube Delta Biosphere Reserve:

- Estimation of the quantitative impact (EIC);
- Number of the great cormorants in the studied zone, number of samples (NC);
- Duration of their presence on the reserve’s territory, besides the nesting and chicks growth, in days (TP);
- Daily quantity of food per sample, in kg (CH);
- Total quantity of food in the nesting and chicks growth period, in kg (CHc);
- Official data of fish capture in the studied zone, in kg (CP);
- Estimation of the economic impact (EIE);
- Total marketable quantity of fish (Ctv);
- Total not marketable quantity of fish (Ctn);
- Medium price for different fish ranges (Pm).

The estimation of the quantitative impact, in tones of fish, would be an approximate equation:

$$\mathbf{EIC = (NC \times TP \times CH) + CHc}$$

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For the estimation of the economic impact (EIC), the total quantity of fish consumed by the Great Cormorants per year (EIC) must be fragmented in two parts: the total marketable quantity (Ctv) and the total not marketable quantity (Ctn). Ctv can be also transposed in the market price, calculating a medium price for different ranges (Pm). The following calculation formula will be obtained:

EIE = (EIC – Ctn) x Pm

The total marketable quantity (Ctv) and the total not marketable quantity (Ctn) will be obtained from the data regarding the qualitative impact of the Great Cormorant upon the delta's ichthyofauna.

Results and discussions

The qualitative impact of the Great Cormorant upon the Danube Delta's ichthyofauna is put into evidence by the analysis of the 8 Great Cormorants samples stomachs' contents (Table 1) and by the trophic spectre identified in the 16 samples of regurgitations in the mixed nesting colony Purcelu (Table 2).

TAB. 1 - THE TROPHIC SPECTRE OF THE GREAT CORMORANTS COLLECTED SAMPLES (CUZIC, 2004)

Specia	**Nr. stomacuri în care s-a identificat specia**	Frecvența speciei %	**Nr. exemplarelor găsite**
Carassius auratus gibelio	4	50,00	5
Abramis brama	2	25,00	2
Cyprinus carpio	1	12,50	1
Esox lucius	1	12,50	1
Scardinius erithrophtalmus	1	12,50	1
Stizosteidon lucioperca	1	12,50	1
Blicca bjoerkna	1	12,50	2
Vimba vimba carinata	1	12,50	1
Silurus glanis	1	12,50	1
Rutilus rutilus	1	12,50	1

It can be noted that the 8 studied samples present a trophic spectre consisting in 10 components and the silver crucian carp (*Carassius auratus gibelio*) has the higher frequency – 50%, followed by the bream (*Abramis brama*) – 25%, the other species having a frequency of 12.5%. From the economic side, the 10 species of fish which compose the trophic spectre at the collected birds have a high and very high economic value.

Tab. 2 - The trophic spectre identified in the 16 regurgitation samples from the mixed colony Purcelu is composed by 14 species of fish (CUZIC, 2004)

Specia	Nr. de regurgitări în care s-a identificat specia	Frecvența speciei %	Nr. exemplarelor găsite
Carassius auratus gibelio	8	50,00	17
Rutilus rutilus	3	18,75	4
Alburnus alburnus	3	18,75	10
Blicca bjoerkna	2	12,50	2
Scardinius erytrophthalmus	2	12,50	2
Acerina cernua	2	12,50	3
Perca fluviatilis	2	12,50	4
Lepomis gibosus	2	12,50	2
Cyprinus carpio	1	6,25	1
Leucaspius delineatus	1	6,25	1
Esox lucius	1	6,25	1
Silurus glanis	1	6,25	1
Styosteidon lucioperca	1	6,25	1
Aspius aspius	1	6,25	1

Their frequencies in the food of the Great Cormorants of the colony Purcelu are: the silver crucian carp – 50%, the roach – 18.75%, the Danube bleak – 18.75%, the white bream – 12.50%, the rudd – 12.50%, ghibort – 12.50%, the perch – 12.50%, the pumpkinseed sunfish – 12.50%, the others – 6.25% (Table 2).

The number of the Great Cormorants from the studied zones, (NC), is about **42,000,** resulting from the following calculation: 15,000 nesting braces estimated X 2 = 30,000 samples + 30% - sub adults which can not be counted in the colonies' frame + 10% - the unfound or unobserved nests (CUZIC, 2004).

The duration of their presence on the Danube Delta Biosphere Reserve territory, besides the period of nesting and chicks growth, appreciated in days (TP), is calculated by making the difference between the about 300 days/year (CUZIC, 2004) and the about 80 days necessary for nesting and chicks growth, the result being **220** days.

The daily necessary of food/sample, in kg, (CH), is estimated at maximum **0.55 kg** (PAPADOPOL, 1955).

The total quantity of food, in kg, for the period of nesting and chicks growth (80 days, respective 30 days – the period of incubation of the laying of eggs + 50 days – the period of chicks growth) (CHc) is **1,734,000 kg**. This number results from the multiplication of the 57.8 kg fish/adult sample – the quantity consumed in the period of nesting and chicks growth (GREMILLET, ARGENTIN, 1998), with 30,000 nesting samples.

Thus, using these data and applying the formula **EIC = (NC x TP x CH) + CHc**, he following result is found:

EIC = (42,000 x 220 x 0.55) + 1,734,000 = 6,816 t

Thus, the total quantity of fish consumed by the Great Cormorants from the Danube Delta per year is estimated at about 6,816 t. The level of the lasting capture of fish from the Danube Delta Biosphere Reserve is estimated at 7,783 t. That means the fact that only the Great Cormorants consume yearly 87.57% of the total quantity of fish estimated capture.

To make the estimation of the economic impact (**EIE**), the total marketable quantity of fish (Ctv) and the total non marketable quantity of fish (Ctn) were approximated using the result of the quantitative impact estimation:

- the total marketable quantity (Ctv) was obtained taking account of the Table 2 data, where 78.6% represents the marketable species, resulting a quantity of 5357.3 t;
- the total non marketable quantity (Ctn) represents 21.4%, resulting 1,458.7 t without economic importance;
- the medium price for the different ranges of fish (Pm) was considered 5 RON/kg.

Applying the formula **EIE** = (**EIC – Ctn) x Pm**, for the estimation of the economic impact, the result is

EIE = **(6816 – 1458. 7) x 5 = 26,786,500 RON** or
267,865,000,000 ROL or
7,440,694 Euros

Conclusions

A detailed estimative calculation, separately for the Danube Delta and Romanian littoral, is necessary, its general form being that of the estimation of the impact in the Danube Delta Biosphere Reserve.

The numbers resulted from the estimations of the quantitative and economic impact cannot be used as reference data, these calculations (in the actual presentation) having the role of providing an overview of the impact of the Great Cormorant from the Danube Delta.

The lasting fish capture of the Danube Delta Biosphere Reserve is estimated at about **7,783 t** and the total quantity of fish consumed only by the Great Cormorant, besides the ichthyophagist birds, is about **6,816 t**. So, if we report this quantity to the estimated lasting fish capture, the result is that they consume 87.57 % of it.

From the estimation of the economic impact, the amount resulted is **26,786,500 RON** or 267,865,000,000 ROL or 7,440,694 Euros.

Many times, the biologists defended the ichthyophagist birds, underlining the facts that the great majority of the fish consumed by them has a trifling value and they represent an important selective and sanitary factor. Speaking about the Great Cormorant, these arguments don't reflect the entire truth.

The estimations resulted of the present study can contribute as arguments to the fish breeding people's advantage, sustaining their opinion saying that the ichthyophagist birds cause important damages to the national economy and the diminution of the widely spread species' effectives is necessary.

Rezumat

Vom încerca în continuare să scoatem în evidență impactul cormoranului mare asupra ihtiofaunei din R.B.D.D., prin prezentarea de date privind impactul calitativ al acestuia în deltă şi efectuarea de estimări în ceea ce priveşte impactul cantitativ şi economic asupra ihtiofaunei şi pisciculturii din R.B.D.D..

Captura durabilă din R.B.D.D. este estimată la circa **7.783 t,** iar cantitatea totală de peşte consumată numai de către cormoranul mare, dintre păsările ihtiofage, este circa **6.816 t**. Deci, dacă raportăm această cantitate la captura durabilă estimată pentru R.B.D.D., vom vedea că aceştia consumă 87,57 % față de aceasta.

Din estimarea impactului economic reeiese suma **26.786.500 RON** sau 267.865.000.000 ROL sau 7.440.694 euro.

În nenumărate rânduri, biologii au luat apărarea păsărilor ihtiofage, scoțând în evidență faptul că valoarea marii majorități a peştelui consumat este neânsemnată, că reprezintă un important factor selectiv şi sanitar, însă în cazul cormoranului mare aceste argumente nu reflectă în totalitate adevărul.

References

1. CUZIC V., 2004 - *Contribuții la studiul trofobiologiei cormoranului mare (Phalacrocorax carbo) din partea fluvială a Deltei Dunării*. Delta Dunării II, Studii şi cercetări de ştiințele naturii şi muzeologie, Tulcea, Ed. NereaMia Napocae, 149-156.
2. GREMILLET D., ARGENTIN G., 1998 - *Cormorants, shags and fisheries in the Chausey Islands area*. Le Cormoran, 10 (47), 196-202.
3. PAPADOPOL A., 1955 - *Câteva considerente asupra păsărilor ihtiofage legate de problema pescuitului şi pisciculturii*. Buletinul Institutului de Cercetări şi Proiectări Piscicole, 14, 2, 61-70.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 460 – 463

DATA ON THE INFLUENCE OF SEVERAL WEATHER FACTORS ON SMALL MAMMAL CAPTURES IN CEAHLAU MASSIF

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ABSTRACT

NICULĂEŞ C., AMARIUCĂI M., SĂRĂCUŢU O., 2006 - Data on the influence of several weather factors on small mammal captures in Ceahlau Massif. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 460-463.

The research proved the presence of a weak correlation between the variations of weather parameters and small mammal captures in the spruce forest.

Keywords: weather, small mammals, ecology

Introduction

The problem of how much does the weather affect small mammal captures has puzzled many researchers. K. A. Adamczewska (1961) shows that the number of yellow necked mice is dependant on the quantity of food (the fructification of deciduous trees) and on the climatic condition in late autumn, winter and the beginning of spring. R. T. Lewelken and S. H. Vessey (1998) came to the conclusion that the variability of population size is explained in equal proportions by density-dependent and density-independent factors.

The aim of the present paper is to analyze the influence which the variations in temperature and precipitations have on the number of small mammal captured in traps used for their study.

Materials and methods

The research was carried out during 2004, in Ceahlau National Park. In order to capture the animals two types of traps were used simultaneously: the pitfalls and the metallic spring traps. In order for the results to be comparable, each capturing was done with the same number of traps (25 pitfalls and 10 spring traps), distributed in a 50x50 m sample trap. The traps were checked in the morning and the number of trapped animals was recorded. Meteorological data recordings were used concerning maximum temperature, minimum temperature, average temperature and precipitation levels, from the day preceding the capture. The study was carried out in 5 sampling areas located in two types of habitat that are representative for Ceahlau Massif: the mixed forest (mainly beech, spruce and silver fir) and the spruce forest. In order to make sure that differences in habitat do not affect the result of the estimation, the spruce forest and the mixed forest were analyzed separately. In each of the two habitats were tested the correlations between meteorological variations and the number of small mammals trapped in the following morning. The capturing effort was of 28 nights, and 126 individuals were caught. The values of the correlation index were calculated, and then tested for statistical significance (the correlation is considered to be statistically significant if the calculated *t* value is higher than *t* critical for α=0,05 and n-2 degrees of freedom). The statistical analysis was done according to the methods presented in Varvara et al, 2001.

Results and discussions

In the mixed forest, the values of the correlation index between meteorological parameters that were investigated and the number of small mammals captured per sample are small, and are not statistically significant (Tab. 1, Figs. 1-4).

In the spruce forest a much stronger correlation was observed between climatic variables and capture (Tab.2). The correlation between minimal temperature and the number of captured

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animals, as well as the between average temperature and the number of individuals captured are statistically significant. The correlation between the maximum temperature and the number of captured animals is close to being statistically significant (Figs. 5-8). We believe these findings to be the result of the spruce forest's homogeneity as a habitat, conditions in which the weather variations affect in a greater degree the activity of small mammals. In contrast, the mixed forest is a more heterogenic habitat, offering better protection from the elements. An explanation for the generally low values for correlation index is the recognized adaptability of small mammals which are known to live in variant climate conditions, their numbers being conditioned more by food availability and by other density dependent mechanisms.

In both types of habitat the most important climatic factor proved to be the minimal temperature, then the average temperature and maximal temperature, results confirming data brought by other researchers. As small mammals are mainly nocturnal and the research was done in a relatively cold mountainous area, it was expected the low temperature during the night to be a limiting factor for their activity. On the other hand, the very small correlation values obtained for the precipitation levels are explained by the fact that there were many days with no precipitations, a fact which affected the analysis.

Tab. 1 - The values for the correlation between variables analyzed in the mixed forest and significance testing

Variables analyzed	*Value of correlation index (r)*	*n-2*	*t calculated*	*t critical (α=0,05)*
t max/nr. Ind	0,43	13	1,48	2,16
t min/nr. Ind	0,35	13	1,21	2,16
t aver./nr. Ind	0,41	13	1,42	2,16
Precipitation/nr. Ind	0,09	13	0,33	2,16

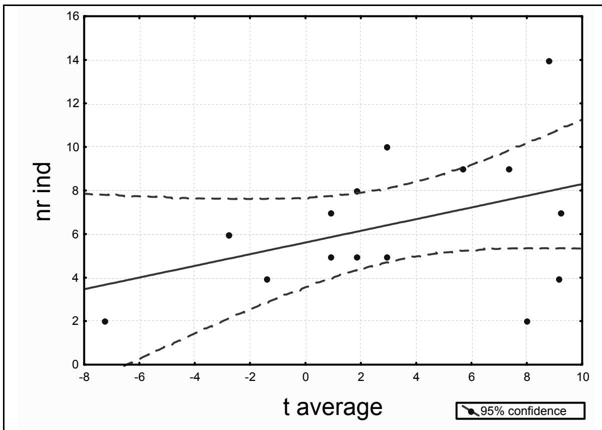

Fig. 1 - Representation of the correlation between the average temperature and the number of small mammals captured in the mixed forest (statistically not significant)

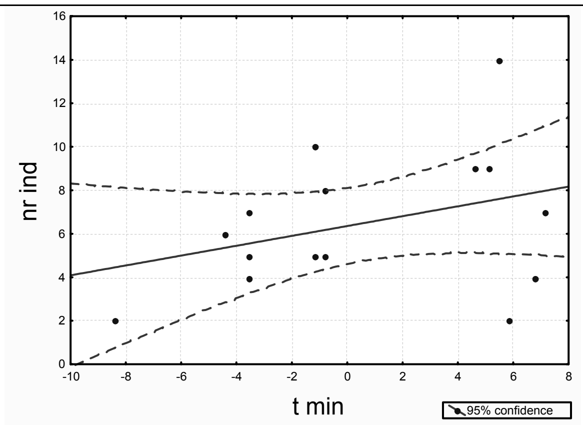

Fig. 2 - Representation of the correlation between minimum temperature and the number of small mammals captured in the mixed forest (statistically not significant)

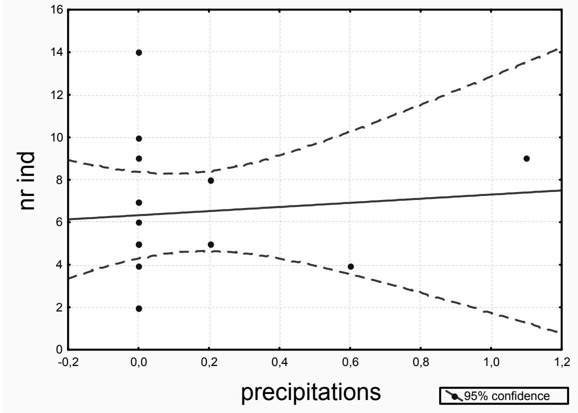

Fig. 3 - Representation of the correlation between the level of precipitations and the number of small mammals captured in the mixed forest (statistically not significant)

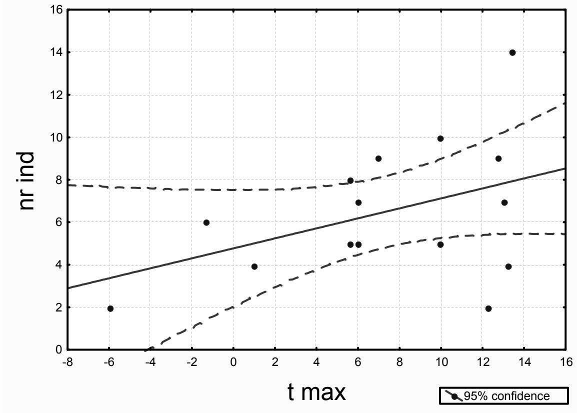

Fig. 4 - Representation of the correlation between maximum temperature and the number of small mammals captured in the mixed forest (statistically not significant)

Tab. 2 - The values for the correlation between variables analyzed in the spruce forest and significance testing

Variables analyzed	*Value of correlation index (r)*	*n-2*	*t calculated*	*t critical (α=0,05)*
t max/nr. Ind	0,54	11	2,13	2,2
t min/nr. Ind	0,59	11	2,44	2,2
t aver./nr. Ind	0,57	11	2,32	2,2
Precipitation/nr. Ind	-0,17	11	-0,59	2,2

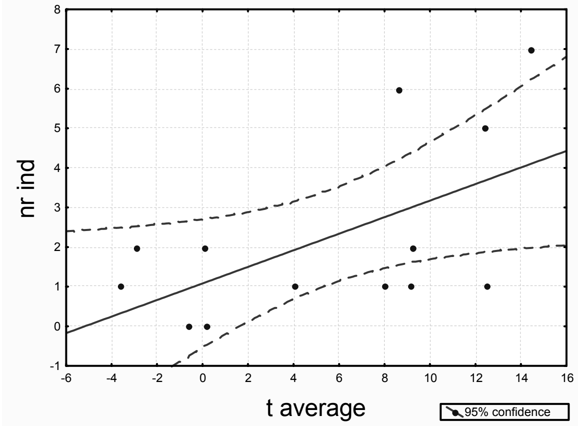

Fig. 5 - Representation of the correlation between average temperature and the number of small mammals captured in the spruce forest (statistically significant)

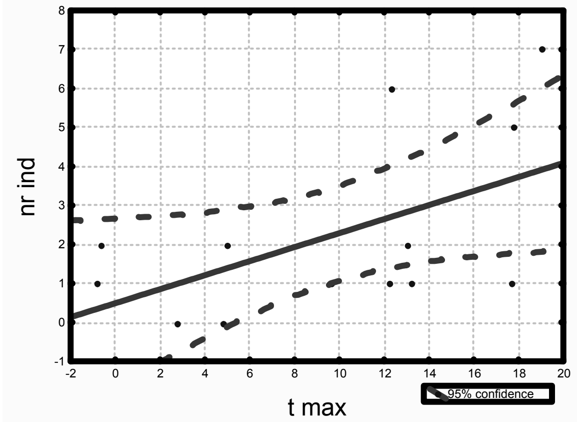

Fig. 6 - Representation of the correlation between maximum temperature and the number of small mammals captured in the spruce forest (statistically significant)

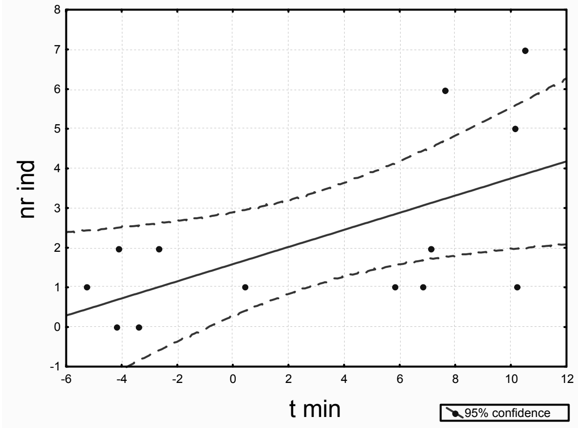

Fig. 7 - Representation of the correlation between minimum temperature and the number of small mammals captured in the spruce forest (statistically significant)

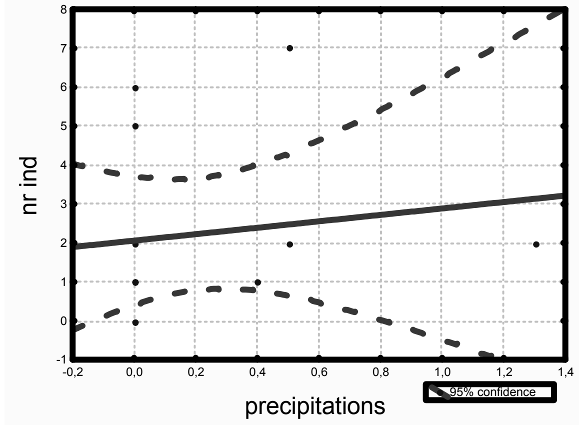

Fig. 8 - Representation of the correlation between the level of precipitations and the number of small mammals captured in the spruce forest (statistically not significant)

Conclusions

In the spruce forest, there is a weak (but statistically significant) positive correlation between the variation of some climatic factors and small mammal captures.

In the mixed forest, there is no statistically significant correlation between the variation of climatic factors and small mammal captures.

The climate variable with the highest effect on small mammal captures was minimal temperature.

Rezumat

In urma cercetarilor efectuat s-a demonstrat existenta unei corelatii slabe intre variatia paramentrilor climatici si capturile de micromamifere in padurea de molid. In padurea de amestec, nu exista o corelatie semnificativa statistic intre variatia factorilor climatici si capturile de mamifere mici.

References

1. ADAMCZEWSKA K. A., 1961 – *Intensity of reproduction of Apodemus flavicollis (Melchior 1834) during the period 1954-1959*. Acta theriologica, vol. V, fasc. 1, p. 1-21, Bialowieza
2. BEGON M., HARPER J. L., TOWNSEND C. R., 1996 - *Ecology - Third edition*. Blackwell Science.
3. GOMOIU M., SKOLKA M., 2001 - *Ecologie – metodologii pentru studii ecologice*. Universitatea „Ovidius” Constanța.
4. LEWELLEN R.H., VESSEY S.H., 1998 – *Modeling biotic and abiotic influences on population size in small mammals*. Oeologia, vol. 113, p 210-218, Ed. Springer-Verlag.
5. MURARIU D., 2000 - *Fauna României, Mammalia, vol. XVI, fasc. 1, Insectivora*. Ed. Academiei Române.
6. MURARIU D., 2000 - *Fauna României, Mammalia, vol. XVI, fasc. 2, Rodentia*. Ed. Academiei Române.
7. VARVARA M., ZAMFIRESCU ŞT., NEACŞU P., 2001 - *Lucrări practice de ecologie*. Ed. Univ. „Al. I. Cuza”, Iaşi.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

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PRELIMINARY DATA ON FOOD AVAILABILITY FOR RODENTS IN CEAHLAU NATIONAL PARK

OANA SĂRĂCUȚU, LĂCRĂMIORA IVĂNESCU, CLAUDIU NICULĂEŞ*

ABSTRACT

SARACUTU O., IVANESCU L., NICULAEŞ C., 2006 - Preliminary data on food availability for rodents in Ceahlau National Park. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 464-467.

The food availability for rodents was studied in a mixed forest on Ceahlau Massif. Stomach contents analyzed of 7 *Apodemus flavicollis* individuals revealed a varied diet, consisting largely of hard vegetal parts: bark, roots, stems, and large chewed seeds.

Keywords: yellow neked mouse, stomach contents, mixed forest, Ceahlau Massif

Introduction

Numerous researches done in various forest habitats suggest that rodents belonging to the Muriade family feed mainly on tree seeds but also on plantlets or grasses.

J. Margaletic, M.Glavas and W. Baumler (2001) consider that Apodemus species are typically granivorous, while species of the Clethrionomys genus consume boths seeds and grasses. In the study that A. Drozdz done on *Apodemus flavicollis* in a forest ecosystem (Drodz A., 1966), he found that tree seeds (*Fagus sylvatica, Quercus pedunculata, Carpinus betulus, Picea excelsa*) were encountered in the stomach in the highest proportion (between 73and 100%) in all vegetation seasons. The diet of the yellow-necked mouse is vegetarian, but animal parts can also be frequently encountered. Apodemus species are granivorous-frugivorous rodents which prefer to feed on the seeds and fruits of many trees and grasses (*Quercus sp., Tilia sp., Fraxinus sp., Acer sp.,Rosa canina, Crataegus monogyna, Cornus mas, Prunus spinosa*, *Malus sylvestris, Pirus piraster*). In winter, in the absence of trhe preferred food, they consume bark, roots and shoots of trees and shrubs (Popescu Alexandrina et al., 2001).

Ecological research carried out in Babadag forest (Donita, 1971) showed that explosive breeding of *Apodemus flavicollis* is correlated with years of rich fructification by oak, when the number of germinable seeds in the next spring decreases considerably.

This study aims to analyze the food items of the yellow necked mouse in the particular conditions present in the mixed forest that covers the lower part (800-1100 m altitude) of the Ceahlau Massif.

Material and methods

Over 2006 *Apodemus flavicollis* was the most abundant species in captures, and it was also present in each vegetation season, allowing this study to be made.

Capturing were carried out in Ceahlau Massif, in a habitat represented by a mixed forest with bushes in which the species with the highest proportion is sylver fir (*Abies alba*) – 50%, followed by spruce (*Picea abies*) 30% and beech *(Fagus sylvatica*) 20%. Where the arboreal layer has a high coverage, the shrub and grassy layer is poor. But where the coverage of the tree crowns is less than 50% a bush layer is well developed, represented mostly by raspberry (*Rubus ideus*) 70%, (*Rubus fruticosus*) 20%, and beech seedlings of various ages. Among grassy species considered as a potential food source for rodents we mention: *Petaistes albus* and *P. hybridus* (approx 30%), *Oxalis acetosella* (aprox. 40%), *Mycelis muralis*, *Glechoma sp.*, *Fragaria vesca, Geum urbanum,*

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Senecio nemorensis, *Euphorbia sp*., *Mercurialis perennis, Epilobium montanum, Prunella vulgaris, Urtica dioica, Atropa belladonna, Scrophularia nodosa, Luzula sp*., numerous ferns. Spontaneous grasses have high density (over 75%) in areas in which the coverage of trees is low (less than 40%).

67 microscopic samples of stomach contents from 7 *Apodemus flavicollis* individuals captured in different vegetation seasons over 2006 were analyzed. The first three individuals were captured in February, when the soil was covered with a thin layer of snow. A single individual was captured in April (a period considered by many authors to be critical from the food availability point of view) when the prevernal and vernal vegetation is not yet well established, and the last 3 analyzed individuals were captured in June, when the forest vegetation is well established.

The analysis of food items was done both macroscopically (by magnifier) and also microscopically for a more detailed analysis of food components.

The microscopic analysis was done on stomach contents preserved in alcohol (90%). The observed fragments were classified in five categories: green parts (represented by leaves or green stems), whole seeds, hard vegetal parts (bark, roots, stems, and large chewed seeds), invertebrates and non-identified fragments.

The quantitative evaluation is done by establishing a numerical coefficient, on the form of value classes. These classes are obtained based on proportion of foods components in each microscopic slide. If no food component on the slide, the mark is 0, between 1% and 20%is 1; between 21% and 40%: 2; between 41% and 60%: 3; between 61% and 80%: 4 and if the proportion is higher than 81% the class is 5.

Discussions

In a habitat like the mixed forest, the most abundant food items available for rodents are represented by roots, bark, and tree seeds. The seeds of coniferous and deciduous species which are to large to be swallowed whole also fit

in the hard material category and are probably a very important food item due to their high energy content. In the table present below, the most frequent value classes is represented by the hard vegetal parts.

Te green parts (see Fig. 1, left) are less looked for because they are poorer in nutritive substances and is the second items found in the stomach contents. The seeds (see Fig. 1, right) of grass species, although rich in energy are less present in the yellow necked mouse's diet due to their low density in the forest ecosystem.

The presence of invertebrate remains proves once more the adaptability and opportunism of this rodent which is not exclusively vegetarian.

The results of our investigations seem to confirm the conclusions of other studies done on the diet of the yellow necked mouse but the researches will continue in order to precisely identify vegetal components and also the species from which they belong.

Tab. 1 - The classification of the main food components of *Apodemus flavicollis* according to their proportion on the microscopy slides used for stomach content analysis:

No. of slide	Value classes				
	green parts(leaves or green stems)	whole seeds	hard vegetal parts	invertebrates	non-identified parts
1	2	0	4	0	1
2	1	0	4	0	0
3	1	0	4	0	1
4	0	0	5	0	0
5	1	0	5	1	0
6	0	0	5	0	1
7	1	0	4	0	0
8	1	0	5	0	0
9	0	0	5	0	0
10	1	0	5	0	1
11	2	0	5	0	0
12	1	0	4	0	0
13	1	0	4	0	0
14	1	0	4	0	1
15	0	0	5	0	0
16	1	0	5	0	1
17	1	0	5	0	1
18	0	0	5	0	0
19	2	0	4	0	1
20	2	0	4	0	0
21	1	0	4	0	0

22	0	0	5	1	1
23	1	0	5	0	1
24	1	0	5	0	0
25	1	0	4	0	1
26	0	0	4	1	0
27	0	0	5	0	0
28	2	0	3	0	0
29	1	0	4	0	1
30	1	4	2	0	0
31	1	4	2	0	1
32	2	3	1	1	0
33	1	4	3	0	1
34	1	3	2	0	1
35	2	4	1	0	0
36	1	2	1	0	1
37	0	3	1	0	1
38	2	1	1	0	1
39	1	2	2	0	2
40	1	2	1	1	1
41	2	1	2	0	1
42	0	3	1	1	0
43	0	2	1	0	1
44	1	3	2	0	0
45	0	1	2	0	1
46	2	1	1	0	1
47	0	0	0	0	3
48	1	3	2	0	1
49	1	3	1	1	1
50	0	2	1	0	2
51	2	2	1	0	1
52	1	3	1	1	1
53	1	2	2	0	1
54	1	2	2	0	0
55	0	3	2	1	1
56	1	2	1	0	0
57	0	0	2	1	1
58	0	0	1	1	2
59	1	0	1	0	2
60	0	0	1	0	1
61	0	0	2	1	2
62	0	0	5	0	1
63	0	0	4	0	1
64	0	0	4	1	1

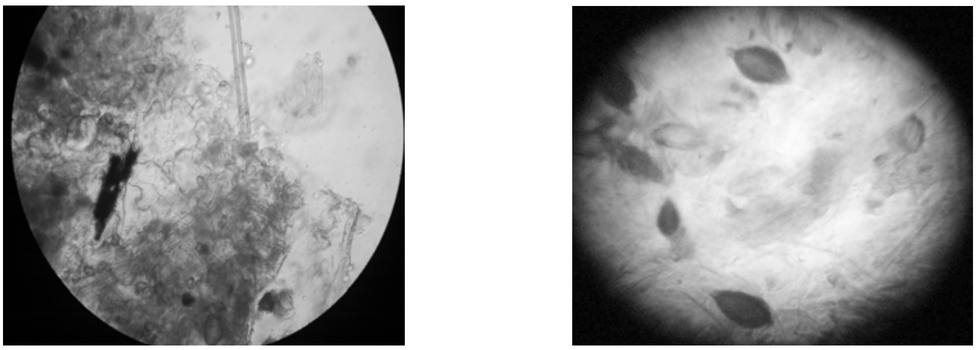

Fig. 1 – Vegetal compound observed on microscopy (left – epidermal fragments; right – whole seeds of grasses)

Rezumat

Disponibilitatile de hrană pentru micromamifere a fost studiate intr-o padure mixta de foiase si conifere din masivul Ceahlau. Continutul stomacal al sapte indivizi de *Apodemus flavicollis* analizat, a scos la iveala o dieta variata, in care predomina partile vegetale tari, reprezentate de scoarta, radacini, tulpini si seminte mari, masticate.

References

1. ADAN D., 1986 - *Diet of the House Mouse (Mus musculus L.) in two pine and a Kauri Forest*. New Zealand Journal of Ecology, vol. 9, New Zealand
2. DONITA N., 1971 – *Cercetari asupra straturilor inferioare si asupra fenologiei asociatiilor de padure*. In: Cercetari ecologice in podisul Babadag, Editura R.S.R., Bucuresti
3. DROZDZ A., 1966 - *Food habits and Food Supply of Rodents in the Beech Forest*, Acta Theriologica, vol. XI, 363 – 384
4. GIANNONI M. S., BORGHI C.E., DACAR M., CAMPOS M. C., 2005 – *Main food categories in diets of sigmodontine rodents in the Monte (Argentina)*. Mastozoologia Neotropical, 12 (2) 181 – 187, Mendoza.
5. GORECKI A., GEBCZYNSKA Z., 1962 - *Food conditions for Small Rodents in a Deciduous Forest*, Acta Theriologica, vol. 10, 275 – 295.
6. MARGALETIC J., GLAVAS M., BAUMLER W., 2002 – *The development of mice and voles in an oak forest with a surplus of acorns*. Anz. Schadlingskunde/ J. Pest Science 75, 95 – 98, Blackewll Verlag, Berlin.
7. MILLER P. A., WEBB I.P., 2001 – *Diet of house mouse (Mus musculus L.) on coastal sand dunes, Otago, New Zealand*. New Zealand journal of Zoology, vol. 28, 49 – 55
8. POPESCU AL., MURARIU D., 2001 – *Fauna Romaniei, Mamalia, Vol. XVI, Fascicula 2, Rodentia*. Editura Academiei Române.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 468 – 471

MONITORING OF THE EUROPEAN BISON USING RADIO TELEMETRY

SEBASTIAN CATANOIU, RAZVAN DEJU*

ABSTRACT

CATANOIU S., DEJU R. 2006 - Monitoring of the european bison using radio telemetry. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 468-471.

Radio telemetry represents a modern tool for location of radio-signals emitted by a transmitter using a receiver with directional or non-directional antenna. The mammals species (including European bison) are permanently assessed in relation with theirs behaviour, usage of habitats and ecosystems, population's dynamics, diseases' influence, interactions between pray and predator, interactions with humans, etc.

Key words: radio telemetry, European bison, monitoring.

Introduction

The mammals species (including European bison) are permanently assessed in relation with theirs behaviour, usage of habitats and ecosystems, population's dynamics, diseases' influence, interactions between pray and predator, interactions with humans, etc.

In majority of the cases, the research take place by field studies, the data collection being a difficult task taking into consideration difficulty of direct observation, etc.

Results and discussions

Radio telemetry represents a modern tool for location of radio-signals emitted by a transmitter using a receiver with directional or non-directional antenna.

The possible applications of radio – telemetry are: location of radio-tagged animals, monitoring of animals' movements, monitoring of activity patterns, monitoring of physiological parameters of an animal, estimation of a home range, evaluation of habitat preferences, etc.

The necessary equipment for radio telemetry contain: transmitters (radio-collars or abdominal implant), receivers, antennas (non-directional or directional), GPS, compass, topographic maps and data logger or a laptop for stocking of collected information from the field.

The information possible to obtain with telemetric techniques: location of an animal with accuracy up to 10 m ,activity/ non activity (mortality sensor), body temperature, heart-beat rate, estimation of surface necessary for one animal, estimation of habitat preferences, etc.

The basic telemetry systems are divided in 4 groups: ground telemetry, aerial telemetry, GPS (Global Positioning System) telemetry and acoustic telemetry.

From position 1 (selected in order to exist a good reception, usually a higher place), a horizon tour will be done with the antenna. The signals are received by the antenna and sent to the receiver which will phonically warning with an intensity in close connection by transmitter's direction (usually, a radio – collar fitted on the animal's neck). In this way, we can find the correct direction of transmitters. Once established this direction, we measure the orientation using a compass orientation (the angle in relation to the North direction). We mark the position 1 on the map; as well we mark first direction. The observer is moving on the position 2 where the method is repeated. In this way, we find the direction where is situated the transmitters in relation with position 2 and is marked on the map the position 2 and the new direction. At the intersection of these 2 directions it is placed the transmitters. The positions 1 and 2 are determined through a GPS, subsequently being marked on the map. In case of intersection point, the coordinates of this point are firstly marked on the map, the GPS

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being used for transposition on the field. In practice, there are necessary several determinations (the animal is moving, lack of signal, interference, etc.).

The habitat used, the locations recorded, types of activities, the distance in relation with settlements, etc. are inserted in data base and analysed through GIS (Geographical International System).

The number of determinations of the location of monitored animal through radio telemetry depends by what kind of information want to obtain. For instance, determination of interaction between pray and predator requires a continue observation for around 4-12 weeks each year, depending by species and for determination of the size territory are required a minimum of 30 independent location.

The possible additional features of radio telemetry are: radio activation, time programming, remote release mechanism, remote tranquillisation.

A place where bison are monitored using telemetry is in Bieszczady Mountains – Poland, in the Carpathians Mountains. Currently, there are around of 180 animals, several being fitted with radio – collars starting to 2001.

Based on data collected using radio telemetry, were identified first results in Bieszczady Mountains:

- no bison activity was recorded over 1000 meters altitude;
- generally, the European bison in Bieszczady Mountains so far avoid areas around settlements and major roads;
- the area of bison refuges indicates an importance of forest habitats for the bison (a necessity of an access to open landscapes within the refuge is required.

An ambitious project to restore bison in Romanian is ongoing in North- Eastern Carpathians, by Vanatori Neamt Nature Park Administration.

Currently, the herd counts now 13 animals and is planned to be additionally enlarged with available animals. This herd has the best genetic structure and potentially is the best suited for future natural development.

In August 2006, a bison female was radio-collared and already were performed first results in relation with refugees, habitat preferences, etc. The results are not very clear due the short monitoring period which included winter time (animals have a lower spatial distribution in comparision with the seasonal vegetation).

During the next years the animals will be acclimatised in an enclosure which has a length of 7 kilometers and an area of 176 ha in order to establish their bond with the site, and to increase the number of the herd. After this they will be released in family groups of four to six animals, which will be monitored using radio telemetry to assess their habitat use, movements, and preference for refuges. Based on the data gained, the most suitable migration corridors will be identified and proposed as part of a national ecological network.

Acknowledgements

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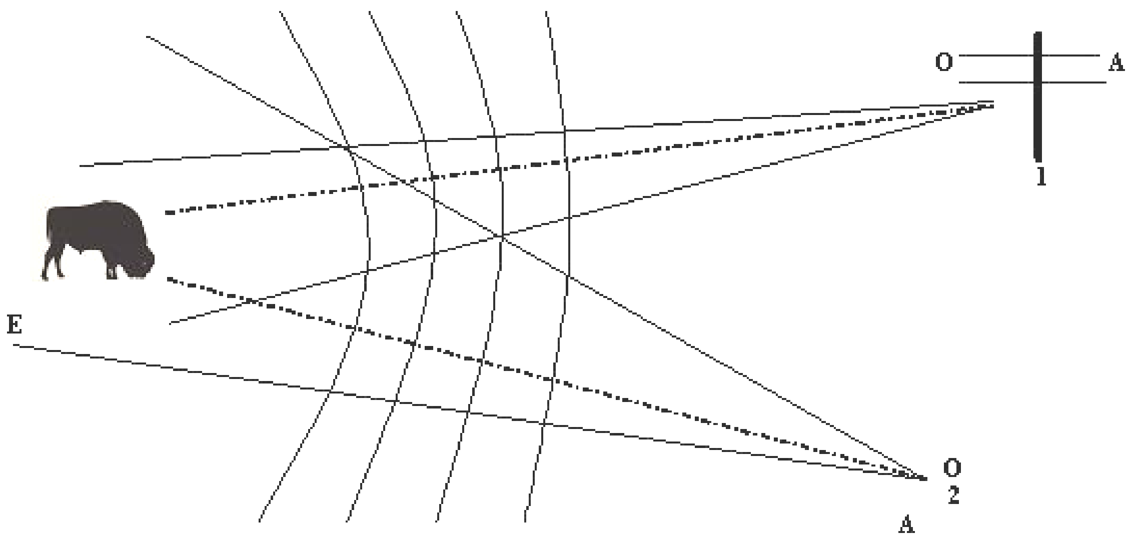
References

1. PERZANOWSKI K.,2001 - *The restitution of the European bison in Bieazczady as a component of re-naturalisation of mountain ecosystems*. Roczniki Bieszczadzkie 9:151-156.
2. PERZANOWSKI K., DEJU R. 2005 - *Romanian free ranging bison as a part of the Carpathian population of the species*. In: Studies and research in Vanatori Neamt Natural Park (R.Deju, S. Catanoju Eds). Vol.1: 104-110.
3. PERZANOWSKI K. OLECH W., BIELECKI W. HŁAWICZKA M. 2005 - *An advancement of the program for captive breeding and reproduction of the European bison at Vanatori Neamt Natural Park*. In: Studies and research in Vanatori Neamt Natural Park (R.Deju, S. Catanoiu Eds). Vol.1: 124-126.
4. WEBSTER R., HOLT S., AVIS C. (EDS), 2001 - *The status of the Carpathians*. WWF – The Carpathian Ecoregion Initiative Report, November 2001.
5. CĂTĂNOIU S., DEJU R., 2006 - *Ținutul Zimbrului* – Manual pentru discipline opționale, 65 pp., Ed. Nona, Piatra Neamț, ISBN 073-7979-29-X.

The principles of radio telemetry:



O- Observer A- antenna E- transmitters 1, 2- successive positions

Fig. 1 - Bison with radio – collars in Bieszczady Mountains

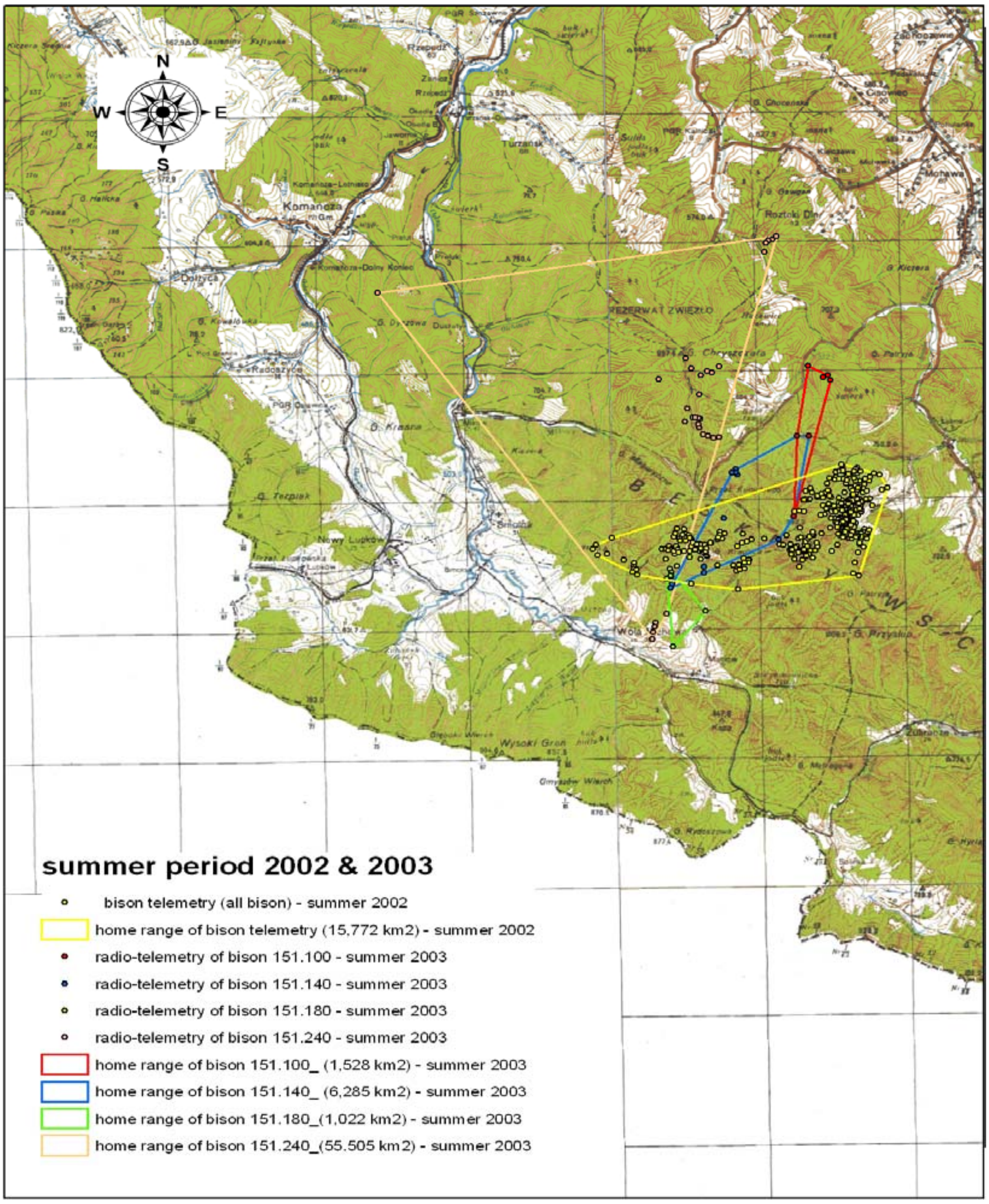


Fig. 2 - A comparison of results of bison telemetry in two consecutive seasons (2002, 2003) after their release to the wild (according to Kajetan Perzanowski)

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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ARCHAEOZOOLOGICAL DATA CONCERNING THE HUNTING IN THE CUCUTENI A COMUNITITIES. CASE STUDY: ARCHAEOLOGICAL SITE FROM HOISEŞTI (IAŞI COUNTY)

ROMEO CAVALERIU *, LUMINIȚA BEJENARU *

ABSTRACT

CAVALERIU R., BEJENARU L., 2006 - Archaeozoological data concerning the hunting in the cucuteni a comunitities. Case study: archaeological site from Hoiseşti (Iaşi county). *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 472-476.

The present paper includes the general data concerning an assemblage of wild animal remains found in the Cucuteni A culture site from Hoiseşti (Iaşi County). Our preliminary study refers to anatomical and taxonomical identification, quantification and paleoecological evaluation of the Chalcolithic settlement from Hoiseşti. Also, our paper provides certain comparative information on the Cucuteni A samples previously analysed.

Keywords: Archaeozoologie, Cucuteni Culture, Hoiseşti, Wild Mammals.

Introduction

In the Cucuteni settlements, according to previously archaeozoological studies, the hunting importance varied from one site to other. In the actual stadium of the archaeozoological research it's not any clear correlation between certain geographical conditions or/and cultural fazes and hunting practice, but certainly the new analyses will make it evident.

The Chalcolithic Cucuteni A Culture site from Hoiseşti is situated at 47˚12′5″ northern latitude and 27˚19′55″ eastern longitude (Fig. 1), in a meander on the left side of the Bahlui River, corresponding to the right side of the bridge that provides the entrance in the Hoiseşti village (Dumeşti Commune, Iaşi County). Hoiseşti is a meadow settlement in the major riverbed of Bahlui, at about 500 m north from the contact between river and slope. The settlement is situated on a little elevation due to the dejection cone of the Valea S**ără**turii River, an affluent of the Bahlui. The fragment of the dejection cone, included in the Bahlui meander, has the aspect of a sand bank because of the repeated alluvia.

The Chalcolithic Cucuteni A Culture site from Hoiseşti has been recorded in 1988, as a result of the surface archaeological research made by I. Istrov. Later, in 1989-1991, D. Boghian and M. Istov investigated again this settlement and the archaeological results were published in 1997 (Boghian, 1997). In 2003-2004, two rescue archaeological campaigns have been achieved under the coordination of N. Ursulescu (Ursulescu *et al.*, 2004; Ursulescu *et al.*, 2005).

Material and method

The material studied in the present paper represents the faunal remains recovered from the recent excavations (2003-2004) at the Chalcolithic Cucuteni site of Hoiseşti (Iaşi County, Romania). According to the pottery patterns, archaeozoological assemblage belongs to phase A3 of the Cucuteni Culture (Ursulescu *et al.*, 2004; Ursulescu *et al.*, 2005), being dated to 3500-3300 B.C. (Mantu, 1998).

Data from archaeozoological reports published are also included in this study (Fig. 1): Cucuteni, Iaşi County (Haimovici, 1969); Truşeşti, Botoşani County (Haimovici, 1999); Târpeşti, Neamț County (Necrasov & Ştirbu, 1979); Drăguşeni, Botoşani County (Bolomey & Bîlcu, 1988); Dumeşti, Vaslui County (Haimovici, 1989); Bălțați, Iaşi County (Haimovici, 1997); Preuteşti–Haltă, Suceava County (Haimovici, 2003).

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The faunal remains analysis was achieved in the Laboratory of Animal Morphology, Faculty of Biology. Study methodology was specific to archaeozoology, mainly consisting of anatomical and taxonomical identifications, encoding and quantification of data (Udrescu *et al*., 1999). Some biases to this study, such as taphonomic factors and recovery techniques need to be mentioned. The assemblages were not sieved, which may have caused an overrepresentation of the big animals (e.g. red deer, wild boar). The remains of the small species are generally scarce (Table 1). On the other hand the smaller carnivorous such as *Lynx lynx*, *Felis sylvestris*, *Meles meles* or *Vulpes vulpes*, mainly hunted for furs, were probably skinned outside of the human settlements and consequently their skeletal remains are rare in the archaeozoological samples.

Results and discussions

In the archaeozoological assemblage from Hoisesti, we have identified 3475 remains, they being thus distributed: 509 of molluscs (1 snail and 508 shell remains), 3 of birds and 2963 of mammals. The animal remains are strongly broken up, so that only 1557 mammal remains have been identified until species level. A number of 32 fragments have been identified as *Sus* sp., 3 as *Bos primigenius/Bison bonasus*, 7 as *Bos taurus/Cervus elaphus* and 1364 only as mammals. The majority of the faunal remains recovered have a domestic origin, mainly as food remains, and others 80 fragments are artefacts with manufacturing marks. In most of the cases raw material of wild animals (*Cervus elaphus*, *Capreolus capreolus, Sus scrofa ferus*) has been used, but artefacts made of bones and teeth of domestic animals (*Ovis aries/Capra hircus*, *Sus scrofa domesticus*) have also been found. The artefacts, occurring in different states of manufacture respectively use wear, will be analysed in a further publication.

Wild mammals identified in the Hoişeşti assemblage have a high proportion both as NISP (number of identified specimens) – 40.72%, and as MNI (minimum number of individuals) – 44.78%. They consist in 11 species that are shown in Table 1. As game species, wild boar (*Sus scrofa ferus*) is dominant with 21% NISP and 17.91% MNI. Red deer (*Cervus elaphus*) is on the second place as NISP (10.14%) because of the increased number of antler fragments, but as MNI red deer (4.47%) is surpassed by roe deer with 8.95%.

Other seven archaeozoological samples from Cucuteni A settlements are referred to in the present paper (Fig. 1). We have to mention that not all of the assemblages have MNI estimation and for that reason in the comparative table 1 only the NISP values are present. As Table 1 shows, the percentages of wild mammals vary from one site to another. The frequencies of wild mammal remains were calculated from the total number of the identified mammal remains. The frequencies, with a mean of 27%, range between 9.25% at Dumeşti and 55.2% at Truşeşti.

The list of identified wild mammals is relatively long and is shown in Table 1. The most frequent species, such as *Cervus elaphus*, *Sus scrofa*, *Capreolus capreolus*, are present in all of the assemblages, while rare species, such as the carnivores appear mostly in the larger samples.

The quantification of wild mammal remains by NISP (number of identified specimens) shows different proportions between identified wild mammals (Table 1). We can notice the predominance of the large animals: *Cervus elaphus*, *Sus scrofa*, *Capreolus capreolus*, even *Bos primigenius.* The red deer dominates in seven cases and the wild boar only in one – in Hoişeşti. So, we can assume that the main aim of the hunting was for food procurement. Of course, other wild species were also consumed, such as *Lepus europaeus*, *Castor fiber, Ursus arctos* or *Alces alces*. Hunting may also have been practised to obtain fur of species such as the *Lynx lynx*, *Felis sylvestris*, *Meles meles,* maybe *Sciurus vulgaris*, to eradicate predators (carnivorous mammals).

The Cucuteni A sites presented in this paper, are located in a geographical zone favourable for the large forest especial of Quercetum mixtum. In the important river valleys (Prut, Jijia) were alluvial plane forests, even march forests. An intensive forestation could explain why the reed deer was such common wild species valuated in the Cucuteni Culture area, similar to East of the Prut River – specific area for the Tripolie Culture (Haimovici, 1987). Human impact was not very intense, the clearing being not of big proportions.

From the ecological point of view, the list of hunted mammals suggests the exploitation of a certain biotope. Identified wild mammals were grouped corresponding to ecological characteristics in: forest species (*Cervus elaphus, Sus scrofa ferus, Castor fiber, Ursus arctos, Lynx lynx, Felis sylvestris, Sciurus vulgaris, Bison bonasus, Alces alces*), skirt (transitional zone between forest and steppe) species (*Capreolus capreolus, Lepus europaeus and Bos primigenius*) and eurytopic species (*Canis lupus*, *Vulpes vulpes, Meles meles*). Forest species are dominant in all the assemblages, NISP (calculated from the total number of the wild mammal remains) ranging between 58% at Preuteşti and 89% at Cucuteni and Bălţaţi (Fig. 2).

Conclusions

Mammal hunting in the Cucuteni A settlemets was generally of high importance and increased emphasis on game species for some sites (Truşeşti, Hoiseşti, Drăguşeni) suggests an important contribution of the wild animals to the diet. We noticed the dominance of the large animals hunted especially for food procurement such as deer, wild boar, and bovines. Other species, such as the smaller carnivores, are scarce in the assemblages, but these results must be cautiously interpreted due to the taphonomic factors mentioned in the present paper.

Fifteen wild mammal species were archaezoologically identified in the Cucuteni A sites, but the assemblage size has an important effect on the number of wild species identified. The red deer was the most frequently hunted species, excepting the Hoiseşti sample dominated by the wild boar remains.

The height proportions of the forest animal species identified from archaeozoological point of view suggest the existence of the large forests in the environment of the Cucuteni settlements.

Rezumat

Date arheozoologice privind vânătoarea în aşezările culturii Cucuteni A. Studiu de caz: situl arheologic de la Hoiseşti (judeţul Iaşi).

Prezenta lucrare include date generale privind un eşantion de resturi animale descoperite în situl de cultură Cucuteni A de la Hoiseşti (judeţul Iaşi). Studiul nostru preliminary oferă date de identificare anatomică şi taxonomică, cuantificare şi evaluare paleoecologică pentru aşezarea de la Hoiseşti. De asemenea, lucrarea conţine informaşii comparative referitoare la eşantioanele Cucuteni A analizate anterior.

References

1. BOGHIAN D., 1997 - *Nouvelles découvertes des vases cucuténienes de culte dans le département de Jassy*. Studia Antiqua et Archaeologica, Univ."Al.I.Cuza" Iaşi, III-IV: 63 – 74.
2. BOLOMEY AL., MARINESCU – BÎLCU S., 1988 - *Industria osoasă în aşezarea cucuteniană de la Drăguşeni*- Ostrov. SCIVA, 39/4: 331 – 353.
3. HAIMOVICI S., 1969 - *Studiul preliminar al resturilor de faună descoperite în săpăturile din 1961 în staţiunea neolitică de la Cucuteni – Băiceni*. Arheologia Moldovei, VI: 317 – 319.
4. HAIMOVICI S., 1987 - *Quelques problèmes d'archeozoologie cocernant la culture de Cucuteni*. La civilisation de Cucuteni en contexte européen, BAR, Université „Al.I.Cuza" Iaşi, I: 157 – 166.
5. HAIMOVICI S., 1989 - *Studiul materialului paleofaunistic găsit în groapa nr. 7 din aşezarea cucuteniană de la Dumeşti, judeţul Vaslui*. Acta Moldavie Meridionalis, IX–XI: 83 – 89.
6. HAIMOVICI S., 1997 - *Observaţiuni cu privire la resturile animaliere descoperite în staţiunea cucuteniană din faza A_4 de la Bălţaţi (judeţul Iaşi).* Cercetări istorice, Muzeul de istorie al Moldovei, Iaşi, 16: 31 - 37.
7. HAIMOVICI S., 1999 - *Studiul arheozoologic al materialului din aşezarea Cucuteni A de la Truşeşti–Ţuguieta*. Petrescu–Dîmboviţa M., Florescu M., Florescu A. C., Truşeşti–monografie arheologică, Ed. Academiei Române, 31 -37.
8. HAIMOVICI S., 2003 - *Analiza materialului arheozoologic*. Ursulescu N., Ignătescu S., *Preuteşti – Haltă. O aşezare cucuteniană pe Valea Şomuzului Mare*, Casa Editorială Demiurg, Iaşi, 95 – 105.
9. MANTU C. M., 1998 - *Cultura Cucuteni: evoluţie, cronologie, legături*. Bibliotheca memoriae Antiquitatis, Muzeul de Istorie Piatra Neamţ, V: 119.
10. NECRASOV O., ŞTIRBU M., 1979 - *The chalcolithic paleofauna from the settlement of Tîrpeşti*. From prehistory to history in Eastern Romania, BAR International Series, 107: 174 – 196.
11. UDRESCU M., BEJENARU L., HRIŞCU C., 1999 - *Introducere în arheozoologie*. Editura Corson, Iaşi.
12. URSULESCU N., COTIUGĂ V., BODI G., CHIRILĂ L., BOGHIAN D., ŢURCANU S., VĂLEANU M., GARVĂN D., 2004 - *Hoiseşti, com. Dumeşti, jud. Iaşi*. Cronica cercetărilor arheologice din România. Campania 2003, Institutul de Memorie Culturală, Bucureşti, 139 - 142.
13. URSULESCU N., COTIUGĂ V., TENCARIU F., BODI G., CHIRILĂ L., KOGĂLNICEANU R., GARVĂN D., 2005 - *Hoiseşti, com. Dumeşti, jud. Iaşi.* Cronica cercetărilor arheologice din România. Campania 2004, Institutul de Memorie Culturală, Bucureşti, 177 - 178.

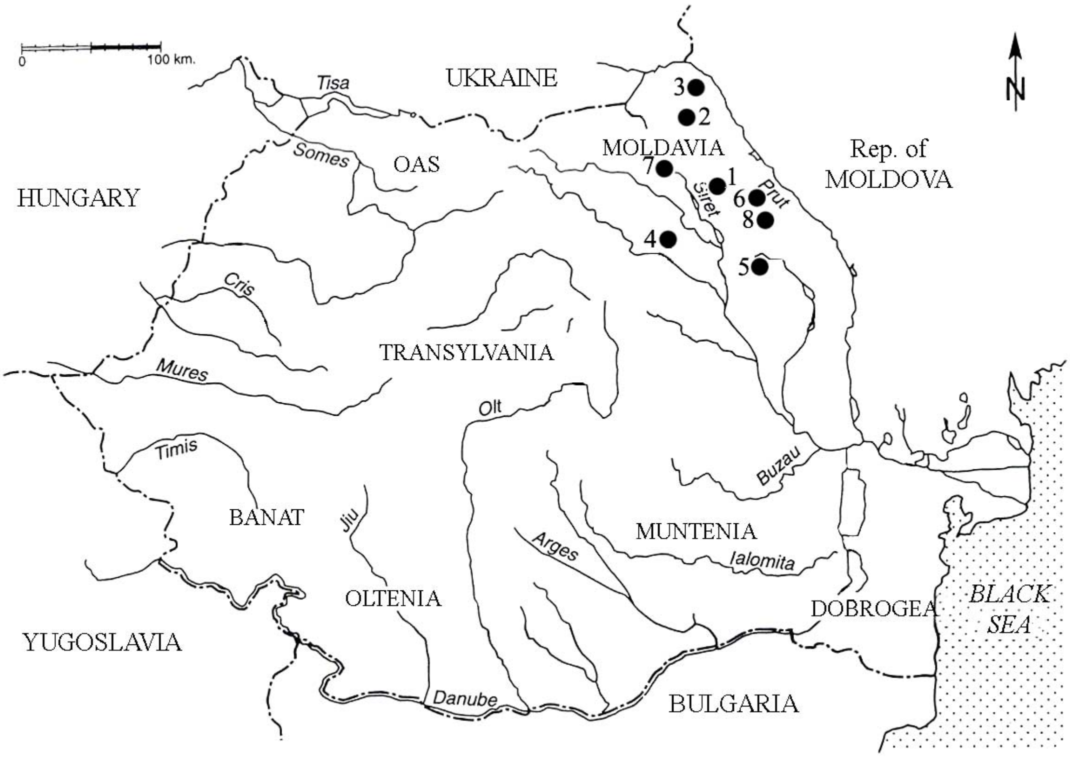

Fig. 1 - Map showing the Cucuteni A sites that have been archaeozoologically analysed (1. Cucuteni; 2. Truşeşti; 3. Drăguşeni; 4. Târpeşti; 5. Dumeşti; 6. Bălţaţi; 7. Preuteşti; 8. Hoiseşti).

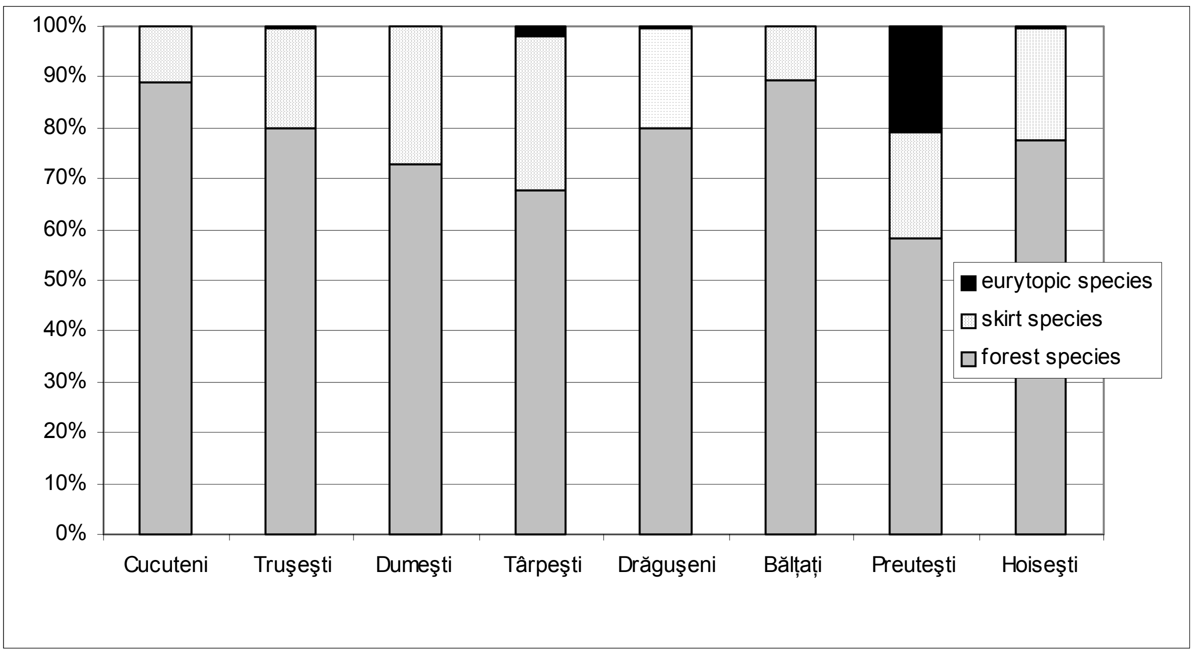

Fig. 2 - Distribution of wild mammal remains according to the ecological characteristics of the species.

Tab. 1 - Relative importance of wild mammal species.

Site	Cucuteni		Truşeşti		Dumeşti		Târpeşti		Drăguşeni		Bălţaţi		Preuteşti Haltă		Hoiseşti	
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Total identified mammals	155		389		119		1505		2568		99		86		1557	
Domestic mammals	119	76.78	174	44.74	108	90.75	1347	89.50	1749	68.10	80	80.80	62	72.09	922	59.22
Wild mammals	36	23.22	215	55.20	11	9.25	158	10.49	819	31.89	19	19.19	24	27.91	635	40.72
Cervus elaphus	21	13.37	103	25.62	4	3.36	87	5.78	436	12.89	9	9.09	11	12.80	158	10.14
Capreolus capreolus	1	0.63	27	6.73	2	1.68	34	2.25	50	1.48	2	2.02	5	5.81	118	7.57
Bos primigenius	2	1.27	13	3.23	1	0.84	11	0.73	110	3.25	-	-	-	-	8	0.51
Sus scrofa ferus	11	7.00	66	16.40	3	2.52	11	0.73	205	6.06	8	8.08	2	2.32	327	21.00
Castor fiber	-	-	1	0.25	-	-	2	0.13	3	0.09	-	-	1	1.16	1	0.06
Ursus arctos	-	-	2	0.49	-	-	2	0.13	5	0.15	-	-	-	-	1	0.06
Canis lupus	-	-	-	-	-	-	-	-	1	0.03	-	-	-	-	-	-
Vulpes vulpes	-	-	1	0.25	-	-	3	0.19	1	0.03	-	-	-	-	3	0.19
Lynx lynx	-	-	-	-	-	-	-	-	3	0.09	-	-	-	-	-	-
Lepus europaeus	1	0.63	2	0.49	-	-	1	0.06	1	0.03	-	-	-	-	13	0.83
Alces alces	-	-	-	-	1	0.84	-	-	-	-	-	-	-	-	-	-
Bison bonasus	-	-	-	-	-	-	-	-	3	0.09	-	-	-	-	-	-
Sciurus vulgaris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.19
Meles meles	-	-	-	-	-	-	-	-	1	0.03	-	-	5	5.81	-	-
Felis sylvestris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.06

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OBSERVATION ON THE VERTEBRATE FAUNA OF PRUT VALLEY

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ABSTRACT

ION I., ION C-TIN, ZAMFIRESCU ŞT. R., 2006 - Observation on the vertebrate fauna of Prut valley. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 477-483.

The observations concerning vertebrate fauna of the Prut Valley have been made since 30 years.

The fish fauna was very affected and modified through: the diking, the built of Stanca Costesti barrage, the regularization of the Prut River, clearing some flood plain forests. In 2006 we identified only 30 fish species distributed in four ecological zones: the first zone of trout from spring to Deleatin (Ukraine); the second zone of broad snout from Deleatin to Stanca Costesti barrage; the third zone of barbell from Stanca to Oancea, the fourth zone of the carp from Oancea to flowing into Danube.

The amphibians include 15 species and the reptiles 9 species, all being protected.

The birds have a great diversity, more than 270 species, the most of them being in the wetlands; 39 species are included in Red List.

The mammals identified comprise 46 species. The manz of them are rodents (19 species), the bats (13 species), the insectivorous (7 species) and one species of rabbit (*Lepus europaeus*).

The great diversity of habitats on the Prut Valley creates the favorable conditions for life of the great vertebrate animal diversity.

Key words: vertebrate fauna, Prut Valley

Introduction

Prut River has its origins in the Carpathians Mountains (on the territory of Ukraine), covers a distance of 939 km and flows into the Danube, east of Galati. On Romanian territory it covers a distance of 704 km.

Prut River flows in the most part from north –west to south-east, and in the lower course from north to south.

The middle Prut borders to the west, from Darabani to Tutora, the Plain of Moldova; and to the east, from Criva to Costesti the Northern Moldavian Plateau, then to Sculeni the Plain of Middle Prut. In the lower course, to the east lays the Central Moldavian Plateau, the Hills of Tigheciu and the Plain of Southern Moldova; to the west we find the Depressions of Raducaneni, Husi, Elan-Horincea and to the south west lays the Plain of Covurlui.

The drainage network of Prut River's middle course comprises numerous tributaries including: Vilia, Larga, Volovat, Baseu, Lopatnic, Racovat, Ciuhur, Camenca, Jijia.

The lower course of Prut spans from the meeting with Jijia until its end, over a distance of more than 400 km. The longest effluents in this segment are: Garla Mare, Narnova, Sarata, Tigheci, Elan, Horincea.

Among natural lakes in Prut Valley are the following: Beleu, Manta, Rotunda, Dracele, Brates; and they are connected to the river through numerous marshes. The river forms a large river meadow which periodically becomes a swamp.

The most important artificial lake in Prut Valley is the one at Stanca-Costesti which spans over 70 km and has a surface of 14000 ha. Other artificial lakes can be found in the lower course of the river: Vlascuta, Pochina, Mata, Vladesti, which offer shelter to a large number of birds and also to some economically important fish species.

Prut River flows into the Danube near Reni, east of the city of Galati, and thanks to this position it constitutes a continuation of the Danube Delta Biosphere Reserve, representing an important corridor for the migration of birds and certain fish species.

Because this corridor also represent the border between The Republic of Moldova and Romania it has all the premises for being able to preserve a high biodiversity in natural state.

The alterations made four decades ago to natural ecosystems (draining, embankments, cutting

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down of riverside forests, the construction of the dam and accumulation lake at Stanca-Costesti, fisheries) had negative impacts on the flora, vegetation and fauna of this region. In spite this, Prut Valley offers a diverse landscape, with a multitude of species which can live here.

We consider that Prut Valley has all the conditions to constitute a natural park – a transfrontier reserve.

The floristic inventory (Tofan and Chifu, 2002) comprises a number of 1360 species of vascular plants, and 161 vegetal associations have been described.

Concerning the vertebrate fauna, 34 species of fish were identified, 15 species of amphibians, 9 species of reptiles, 275 species of birds and 46 species of mammals.

Materials and methods

The research span on more than 30 years, but data accumulation and programmed observations were done between 2000-2006, in research grants aimed at protected areas from the County of Iasi and the Prut Valley- future transfrontier reserve.

The following instruments were use for the identification of vertebrate species: for birds- the telescope, the binoculars, the photo camera; for fish amphibians, reptiles and small mammals the classical methods were used: the fishing net, the herpetological claw, free observations. Experimental fishing was carried out in several years documenting the modifications that took place in the structure and composition of fish populations.

The research done also points out the antropic impact on Prut River on a period of time reaching back to the 1960, when important modifications took place through the creation of the accumulation lake and the setting down lake.

Results and discussions

The ichthyofauna (Tab. 1). The analysis of Prut River's fish fauna was possible both by personal research, by bibliography (Matei and colab., 1999, Usatâi and colab., 1999, Popa, 1962) but also by data gathering (from dedicated literature), of researchers from the Ihtiology Laboratory of the Institute of Zoology belonging to the Academy of Moldova.

The research carried out in the sector of the Prut River situated on Ukraine's territory (from the source until it enters Romania) showed the presence of fish species characteristic to the ecological zone of the trout (the mountain zone). These species were The American Brook Charr (*Salvelinus fontinalis*), The Brown Trout (*Salmo trutta fario*), The Common Minnow (*Phoxinus phoxinus*), The Schneider (*Alburnoides bipuncatus*). Also in the Ukraine sector of Prut , the following species were found: The Mediterranean Barbell (*Barbus meridionalis petenyi*), The Common Bullhead (*Cottus gobio*), The Alpine Bullhead (*Cottus poecilopus*) and The Rainbow Trout (*Salmo irideus*).

In the portion of the river from where it enters the country (Dorofteana) to where it enters in the accumulation lake at Stanca Costesti 34 species of fish were identified, among which only 6 (16%) of real economical value. These species are: The Asp (*Aspius aspius*) with appox. 1.8%, The Carp (*Cyprinus carpio*) with 1.1 %, The Wells Catfish (*Silurus glanis*) 3.2%, The Crucian (*Carassius auratus gibelio*) with 3.6%, Pikeperch (*Stizostedion lucioperca*) with 1.4 %, The Bream (*Abramis brama*) with 5%. Approximately 84 % is represented by species with low economical value like The Common Gudgeon (Gobio obtusirostris) with 4.3%, The Common Bleak (Alburnus alburnus) with 36.4 %, The Bitterling (*Rhodeus sericeus*) 7.6%, The Spined Loach (*Cobitis taenia*) 3.6% and others.

Experimental fishing carried out in 2006 upstream from the accumulation lake pointed out the presence of the following fish species with economical value: The Common Bleak (*Alburnus alburnus*) in proportion of 88%, The Barbell (*Barbus barbus*) 3%, The Common Chub (*Leuciscus cephalus*) 1.5%, The Asp (*Aspius aspius*) 0.24%, and The Pikeperch (*Stizostedion lucioperca*) 0.24%.

Downstream from the accumulation lake at Stanca Costesti, 8 species of real economical value were fished: The Crucian (*Carassius auratus gibelio*) 11.9%, The Asp (*Aspius aspius*) 7.15 %, The Silver Bream (*Blicca bjoerkna*) 5%, The Barbell (*Barbus barbus*) 5%, The Terek Nase (*Chondrostoma nassus*), The Wells Catfish (*Silurus glanis*), The Perch (*Perca fluviatilis*), and The Pikeperch (*Stizostedion lucioperca*) each with approx. 3%.

In the river sector between Falciu to the confluence with the Danube (the plain zone), economically valuable fish species were identified such as: The Bream (*Abramis brama*) 20%, The Common Roach (*Rutillus rutillus carpathorossicus*) 20%, The Carp (*Cyprinus carpio*) 15%, The Pikeperch (*Stizostedion lucioperca*) 10%, The Wells Catfish (*Silurus glanis*) 10%, and The Orfe (Leuciscus idus). As species with low percentage we mention: The Perch (Perca fluviatilis), The Common Bleak (*Alburnus alburnus*), The Common Bullhead (*Cottus gobio*).

Tab. 1 - The present situation of fish species largely spread in Prut River

Order	Nr.	Species	Evolution of spreading	Evolution of abundance	Protection status
Order Cypriniformes	1	*Abramis sapa*	Expanding	Increases	Not threatened
Order Cypriniformes	2	*Rutilus carpathorossicus*	Constant	Increases	Not threatened
Order Cypriniformes	3	*Leuciscus cephalus*	Constant	Unchanged	Not threatened
Order Cypriniformes	4	*Scardinus erythrophalmus*	Regress	Decreases	Vulnerable
Order Cypriniformes	5	*Aspius aspius*	Expanding	Increases	Not threatened
Order Cypriniformes	6	*Chondrostoma nassus*	Constant	Unchanged	Not threatened
Order Cypriniformes	7	*Gobio obtusirrostris*	Constant	Unchanged	Not threatened
Order Cypriniformes	8	*Barbus barbus*	Constant	Unchanged	Not threatened
Order Cypriniformes	9	*Alburnus alburnus*	Constant	Unchanged	Not threatened
Order Cypriniformes	10	*Abramis brama danubii*	Regress	Decreases	Not threatened
Order Cypriniformes	11	*Vimba vimba carinata*	Constant	Increases	Not threatened
Order Cypriniformes	12	*Carassius auratus gibelio*	Expanding	increases	Not threatened
Order Cypriniformes	13	*Blica bjoerkena*	Expanding	Increases	Not threatened
Order Cypriniformes	14	*Cyprinus carpio*	Constant	Unchanged	Not threatened
Order. Siluriformes	15	*Silurus glanis*	Constant	Unchanged	Not threatened
Order. Salmoniformes	16	*Esox lucius*	Regress	Decreases	Not threatened
Order Perciformes	17	*Stizostedion lucioperca*	Constant	Increases	Not threatened
Order Perciformes	18	*Acerina cernua*	Constant	Increases	Not threatened
Order Perciformes	19	*Proterorhinus marmoratus*	Constant	Increases	Not threatened
Order Perciformes	20	*Asper streber*	Expanding	Increases	Not threatened

A notable fact is that The Common Rudd (*Scardinus erythrophtalmus*) suffers a regress in range, in the last years. Few individuals are found in old meanders that are isolated from the dike which was constructed along the Prut River and in some of the ponds. This species is replaced by populations of The Common Roach (Rutillus rutillus carpathorossicus) which is abundant both in the river but especially in flooded meanders and in retention basins.

Due to intensive fishing in the accumulation lake (Stanca Costesti) The Common Bream (Abramis brama) is in numerical regress. The Carp (Cyprinus carpio) is constant in numbers thanks to the young which escape from intensive breeding ponds. The Pikeperch (Stizostedion lucioperca) is increasing in abundance because it began to be raised in ponds and retention basins.

The Streber (Aspro streber) forms numerous enough populations located in the portion of the river with calm, deep water and a rocky bottom. In autumn 10-12 individuals per day can be caught with a fishing rod.

The ecological division into zones of Prut River's fish fauna (Banarascu, 1964) comprises:

- The Trout zone – the sector from the source until Deleatin (Ukraine)
- The Common Nase zone – the river sector until Stanca Costesti accumulation lake
- The Common Barbell zone – the river sector from Stanca Costesti dam to Oancea
- The Carp (Common Bream) zone – the Prut sector from Oancea to its confluention with the Danube

Following the construction of the Stanca-Costesti dam, profound changes of the characteristics of aquatic habitats took place downstream form the dam along Prut River. These changes can be summarized as:

- coarse deposits stop in the retention basin;
- river flow is relatively constant (excepting years or periods with heavy rains such as the spring of 2006 when the river flooded a good part of the river meadow);
- the degree of water turbidity is low, so the water is clear;
- fine deposits from agricultural soils in the vicinity of the river brought in by tributaries lay down on the riverbed and favor the development of algal bioderm which attracts a rich fauna of aquatic invertebrates;
- in places with large amounts of fine deposits (silts) begun to develop aquatic vegetation.

These modifications in habitat characteristics meant that the zone of the barbell and the zone of the carp moved upstream, until the dam at Stanca Costesti.

In the retention basins that were construction it is carried out controlled raising of certain fish species: Grass Carp (*Ctenopharingodon idella*), Silver Carp (*Hypophtalmychthys molitrix*), Bighead Carp (*Aristichthys nobilis*), (*Mylopharyngodon piceus*). Together with these species, significant increases in numbers show *Pseudorasbora parva* and The Crucian (*Carasius auratus gibelio*).

The Bighead Carp and The Silver Carp are filter feeders (they consume seston). The Silver Carp reproduce naturally in Prut River.

Many years ago the waters of the Prut River were a very good base for the reproduction of species coming from the Danube. The sturgeons and The Black Sea Shad (*Alosa pontica*) went upstream until Stanca-Costesti. In today's conditions the Black Sea shad disappeared, but from time to time we can find The Sterlet (*Acipenser ruthenus*). In fact it is a hybrid between The Sterlet and The Beluga

Sturgeon (Huso huso), named Bester. This hybrid is fertile and it is raised in fishing ponds in Basarabia. The stellate Sturgeon (*Acipenser stellatus*) disappeared 40 years ago. In 2000 a Russian Sturgeon (*Acipensr gueldenstaedtti*) was captured during a summer flood at Berza, 30 km downstream from the dam.

The Burbot (*Lota lota*) has a special situation. Due to the fact that it is a nocturnal predator he spends the day in veritable underwater burrows and it is very hard to catch. For this reason it is considered a rare species. In winter (December-January) this species makes reproduction migrations in the upper course of the river, reaching the setting down lake in front of the turbines. It was found that in big River floods, The Burbot abandons its burrow and can be frequently captured.

The Crucian Carp (*Carassius carassius*) and The European Mudminnow (*Umbra krameri*) disappeared; The Weather Loach (*Misgurnus fossilis*) and The Tench (*Tinca tinca*) are rare species in pools and ponds.

The Whiteye Bream (*Abramis sapa*) and The Silver Bream (*Blicca bjoerkena*) reproduce in pools and migrate to the river. The Silver Bream remains for the most part in the pools, but The Whiteye Bream returns to flowing waters and because it lives in a fast flowing environment it has a pointy snout (it digs in the sand to look for chironnomid and ephemeropter larvae). The individuals which remain in pools have a classical shape.

The Streber (*Aspro streber*) was absent for almost 20 years. It can now be found in trenches made by sand excavation, in front of the water intakes from Prut River and in the banks with diorite sand.

Reared Carp interbreeds with Wild Carp and we may say that we have a feral carp. Carp breeds without scales do not stay in Prut River.

In Stanca Costesti Accumulation Lake the following fish species are found: The Wells Catfish and The Pike as rare species, The Common Bleak in constant numbers and representing the basic food for predatory species: The Pikeperch, The Perch, The Silver Bream, The Common Bream, The Roach and The Crucian- in small numbers. Towards the tale of the lake we can find The Common Vimba (*Vimba vimba*).

<u>The herpetofauna</u> (Tab. 2) of Prut Valley comprises 15 species of amphibians and 9 species of reptiles. The Snake (*Zamenis (Elaphe) longissima*) was signaled in the area but we do not have the certainty of the observation. All recorded species are protected and included in different official documents (conventions, directives, and orders) (Zamfirescu, 2002).

Tab. 2 - The herpetofauna of Prut Valley

	Species	Bern Convention (1979)	Habitats Directive (1992)	Order No. 1198 (2005)	Observations
Class Amphibians	1. Salamandra salamandra	3		3b	in the river basin
Class Amphibians	2. Triturus cristatus	2	4	2,3a	
Class Amphibians	3. Lissotriton (Triturus) vulgaris	3		3b	
Class Amphibians	4. Bombina bombina	3	2,4	2,3a	
Class Amphibians	5. Bombina variegata	2	2,4	2,3a	in the river basin
Class Amphibians	6. Pelobates fuscus	2	4	2,3a	in the river basin
Class Amphibians	7. Bufo bufo	3		3b	in the river basin
Class Amphibians	8. Bufo viridis	2	4	3a	
Class Amphibians	9. Hyla arborea	2	4	3a	
Class Amphibians	10. Rana ridibunda	3	5	4a	
Class Amphibians	11. Rana esculenta	3	5	4a	
Class Amphibians	12. Rana lessonae	3	4	3b	in the river basin
Class Amphibians	13. Rana dalmatina	2	4	3a	
Class Amphibians	14 Rana temporaria	3	5	3a,3b,4a	in the river basin
Class Amphibians	15. Rana arvalis	2	4	3a	in the river basin
Class Reptiles	1. Emys orbicularis	2	2,4	2,3a	
Class Reptiles	2. Anguis fragilis	3		3b	in the river basin
Class Reptiles	3. Lacerta viridis	2	4	3a	
Class Reptiles	4. Lacerta agilis	2	4	3a	
Class Reptiles	5. Zootoca (Lacerta) vivipara	3		3a	in the river basin
Class Reptiles	6. Natrix natrix	3			
Class Reptiles	7. Coronella austriaca	2	4	3a	
Class Reptiles	8. Vipera berus	3		3b	in the river basin
Class Reptiles	9. Vipera ursini	2	2,4	2,3a	in the river basin
Class Reptiles	Zamenis (Elaphe) longissimus	2	4	3a	not confirmed recently

Legend:
Bern Convention 19-09-1979
2- Annex II Strictly protected species (13 species)
3- Annex III Protected species (12 species)
Habitats Directive 92/43 EEC 21-05-1992
2-Annex II Species of communitarian interest whose conservation needs designation of special conservation areas (4 species)
4-Annex IV Species of communitarian interest which need strict protection (2 species, exclusive)

5 – Annex V Species of communitarian interest whose extraction from nature and exploitation are the object of management measures (3 species).
Order 1198 25-11-2005
2- Annex II Species whose conservation needs designation of special conservation areas (6 species)
3a- Annex 3A Species of communitarian interest which need strict protection (10 species, exclusive or inferior categories)
3b- Annex 3B Species of national interest which need strict protection (6 species, exclusive or inferior categories)
4a- Annex 4A Species of communitarian interest whose extraction from nature and exploitation are the object of management measures (2 species, exclusive).

Avifauna. The existence of a more than 900 km long Prut River course, from which more than 700 km form the border between Romania, the Republic of Moldova and Ukraine; the presence of a large accumulation lake at Stanca-Costesti and of the setting down lake downstream from the dam; the presence of fish rearing lakes and ponds as well as river meanders; the existence of riverside forests and flood plain, they all offer a multitude of habitats for birds, especially aquatic ones.

In spring and autumn migrations, many bird species (Cazacu, 2006, Gache , 2002, Ion & Gache, 1992) travel along Prut River and stop here for some periods in order to feed. When the winters are mild and the water does not freeze many species of aquatic birds remain in the area (such as in the winter of 2006).

From the approximately 370 species of birds present in Romania, in Prut Valley we find more than 270 species.

The density of ornithofauna is high and 147 bird species are included in various international conventions aimed at protecting them (The convention concerning the conservation of wildlife and natural habitats in Europe – Bern, 1979, The convention for the conservation of migratory wildlife species – Bonn, 1979).

The Red List (Botnariuc & Tatole, 2005) of bird species includes 39 species grouped in the following categories: vulnerable species -19; endangered species – 10, rare species – 6, critically endangered species -4.

1. As vulnerable species present on the Prut corridor are the following: The Pygmy Cormorant (*Phalacrocorax pygmaeus*), The White Pelican (*Pelecanus onocrotalus*), in the lower basin, especially on the large lakes Carja-Mata-Radeanu, Brates, Manta, Beleu; The Night Heron (*Nycticorax nycticorax*), The Squacco Heron (*Ardeola ralloides*), The Blak Stork (*Ciconia nigra*), The White Stork (*Ciconia ciconia*), The Geossy Ibis (*Plegadis fulcinellus*), The Shelduck (*Tadorna tadorna*), The Ferruginous Duck (*Aythia nyroca*), The Honey Buzzard (*Pernis apivorus*), The Osprey (*Pandion haliaetus*), The Red-footed Falcon (*Falco vespertinus*), The Avocet (*Recurvirostra avosseta*), The Corncrake (*Crex crex*), The Turtle Dove (*Streptopelia turtur*), The Barn Owl (*Tyto alba*) – which appears in the winter, The Eagle Owl (*Bubo bubo*), The Short-eared Owl (*Asio flammeus*), The Hoopoe (*Upupa epops*).

2. Endangered species are: The Little Egret (*Egretta garzetta*) and The Great White Heron (*Egretta alba*), The Purple Heron (*Ardea purpurea*), The Spoon Bill (*Platalea leucordia*), The Red-breasted Goose (*Branta ruficollis*), The Black-winged still (*Himantopus himantopus*), The Bluethroat (*Luscinia svecica.*). All these are wetland species. To them can add the birds of prey: The Red Kite (*Milvus milvus*), The Palid Harrier (*Circus macrourus*) and among the woodpeckers, The Wryneck (*Jynx torquilla*).

3. Rare species are considered: The Sparrowhawk (*Accipiter nisus*), The Oystercathcher (*Haematopus ostralegus*), The Marsh Sandpiper (*Tringa stagnatils*), The Black-tailed Godwit (*Limosa limosa*), The Snipe (*Gallinago gallinago*), and The Little Gull (*Larus minutus*).

4. Critically endangered species: The Lesser White Fronted Goose (*Anser erythropus*) which appears especially during migration, The Ruddy Shelduck (*Tadorna feruginea*) (in lakes and ponds), The White-tailed Eagle (*Haliaetus albicilla*) along Prut River in riverside forests and The Spotted Eagle (*Aquila clanga*).

On the large lakes in Prut Valley such as: Stanca-Costesti, Brates, Halceni-Vladeni, Mata-Carja-Radeanu, Vladesti, during the winter months appear birds that winter guests: The black Throated Diver (*Gavia arctica*), rare is The Red Throated Diver (*Gavia stellata*), The Whooper Swan (*Cygnus cygnus*), The Pintail (*Anas acuta*), The Common Scoter (*Melanitta nigra*), The Velvet Scoter (*Melanitta fusca*), The Goldeneye (*Bucephala clangula*), The Ferrugious Duck (*Aythya nyroca*), The Smew (*Mergus albellus*).

Mammal fauna. The mammals identified in Prut Valley amount to 46 species, almost half the total number of species found in Romania (99).

Most species are rodents (Aconstantinesei, 2006) -19- and among them we find 9 vulnerable species: The European Souslik (*Spermophyllus citellus*), The Common Dormouse (*Muscardinus avellanarius*), The Garden Dormouse (*Eliomys quercinus*), The Forest Dormouse (*Dryomys nitedula*), The Common Hamster (*Cricetus cicetus*), The Grey Hamster (*Cricetulus migratorius*), The Harvest Mouse (*Mycromis minutus*), The Water Vole (*Arvicola terrestris*), and The Blind Mole-Rat (*Spalax graecus*).

One species is critically endangered – The Jumping Mouse (*Sicista subtilis*).

The other rodent species common in the riverside forests are: The Red Squirrel (*Sciurus vulgaris*), The Wood Mouse (*Apodemus sylvaticus*).

In agricultural fields, barns, deposits we find: The Common Rat (*Rattus norvegicus*), The House Mouse (*Mus musculus*), The Garden Mouse (*Mus spicilegus*), The Field Mouse (*Apodemus agrarius*), The Common Vole (*Microtus arvalis*), The Bank Vole (*Cleithrionomys glareolus*). In wet areas, pools, ponds with lush vegetation, The Muskrat (*Ondatra zibethicus*) makes its nest.

The bats that were identified in Prut basin belong to 13 species oll of them needing protection, and some of which are considered vulnerable: *Eptesicus serotinus, Plecotus auritus, Nyctalus noctula, Pipistrellus pipistrellus* and *Pipistrellus pygmaeus, Myotis nattereri*. Endangered species are: *Vespertilio murinus, Plecotus austriacus, Myotis blythii, Pipistrellus nathusii, Myotis brandtii, Nictalus leisleri*. Critically endangered is the species *Myotis daubentonii*.

Only 7 species belong to the insectivore small mammals (Aconstantinesei, 2006), from which one species, The European Water Shrew (*Neomys fodiens*) is considered endangered. This Shrew digs galleries in dikes and riverbanks.

Vulnerable are considered The Bicolor White-Toothed Shrew (*Crocidura leucodon*) and The Lesser White-Toothed Shrew (*Crocidura suaveolens*).

In riverside forests, meadows and gardens, other insectivores are found: The Lesser Shrew, (*Sorex minutus*), The Common Shrew (*Sorex araneus*), The Mole (*Talpa europaea*) and The Eastern Hedgehog (*Erinaceus concolor*).

From the Order Lagomopha (rabbits) we find The Brown Hare (*Lepus europaeus*), in quite large numbers, pursued by hunters in the hunting season.

Hoofed mammals (Artiodactyla) are represented by The Wild Boar (*Sus scrofa*) present with small populations in the clearings from the riverside forests.

The Elk (Alces alces) is a critically endangered species. The presence of The Elk in Prut Valley is sporadic, isolated individuals come from Ukraine and wander for a good period of time in the area, especially in the cold season. Some of them reached Podu Iloaiei (Iasi), Husi, Varful Campului (Botosani).

The Red Deer (*Cervus elaphus*)- vulnerable species. The Red Dear is rarely found in Prut Valley. One female was seen in august 2006 in a meadow near Prut in Gorban Village.

The Roe Deer (*Capreolus capreolus*)– vulnerable species. In Prut Valley it finds favorable feeding and breeding conditions in agricultural fields bordering riverside forests.

From Order Fissipeda (carnivores), in Prut Valley area 7 species of carnivores were observed: The Red Fox (*Vulpes vulpes*) is a common species in all forests, bush lands, agricultural fields; The Raccoon Dog (*Nyctereutes procynoides*) was observed looking for rodents (as food), but it lives a very hidden life and the hunters catch it in traps; The Badger (*Meles meles*) in low but constant numbers lives in ravines, riverbanks.

The Common Polecat (*Mustela putorius*) and The Weasel (*Mustela nivalis*) are found near houses, in villages.

Vulnerable species among carnivores are: The Otter (*Lutra lutra*) and The Wild Cat (*Felis silvestris*) but because Prut Valley is a frontier zone the access of hunters is limited, so these animals find here a good refuge.

Conclusions

The Prut valley with a lot of habitats and a border with the Republic of Moldova and Ucraina offers all the conditions for life of many plants and animals species.

The vertebrate fauna in accordance with our observations and investigations comprises 34 species of fish. The Prut River has four ecological zones: a) The Trout Zone from spring until Stanca Costesti (Accumulation Lake); The Common Nose Zone - the river sector from Stanca Costesti dawn to Oancea; The Carp (Common Bream) Zone – from Oancea to the confluence with the Danube.

The herpetofauna comprises 15 species of amphibians and 9 species of reptiles, all are protected.

The avifauna has a great variety (more than 270 birds species), many of them live in the wetlands. The Red List includes: 19 vulnerable species; 10 endangered species; 6 rare species and 4 species are critcally endangered.

Mammals identified are 46 species, from which: 19 species of rodents, 13 species of bats; one species of rabit; 7 species of insectivore; 4 species of hoofed and 7 species of carnivores.

Rezumat

Lucrarea cuprinde observații privind componența faunei de vertebrate de-a lungul Văii Prutului, pe o perioadă care însumează 30 de ani.

Fauna peştilor a suferit mari modificări prin: asanări, construirea barajului de la Stânca Costeşti, regularizarea cursului râului Prut, defrişarea unor păduri de luncă. Au fost identificate în Prut mai recent (2006) numai 30 de specii de peşti distribuite în patru zone ecologice: prima zonă a păstrăvului de la izvoare până la Deleatin (Ucraina); a doua zona a scobarului (de la Deleatin la barajul Stânca-Costești); a treia zonă a mrenei de la barajul Stânca până la Oancea; a patra zonă a crapului (plăticii)-sectorul de la Oancea până la vărsarea în Dunăre.

Amfibienii includ 15 specii şi reptilele 9 specii, toate fiind ocrotite prin lege.

Păsările prezintă o diversitate foarte ridicată, peste 270 de specii, cele mai multe fiind în zonele umede; 39 de specii de păsări sunt incluse în Lista Roşie.

Mamiferele identificate până în prezent cuprind 46 de specii. Cele mai multe sunt rozătoarele (19 specii), liliecii (13 specii), insectivorele (7 specii) şi o specie de lagomorfe (iepurele de câmp).

Marea diversitate a habitatelor de pe valea Prutului creează condiţii favorabile pentru viaţa unei mari diversităţi de animale vertebrate.

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References

1. ACONSTANTINESEI M., 2006- *Biodiversitatea mamiferelor mici (Mammalia: Rodentia, Insectivora) din diferite agroecosisteme din nordul Moldovei*. Teza de doctorat, Univ. „Al. I. Cuza", Iasi
2. BĂNĂRĂSCU P., 1964- *Fauna R.P.R., Pisces-Osteichthyes* Vol. XIII, Edit. Acad. R.P.R., Bucureşti
3. Botnariuc, N., Tatole V., 2005 - *Cartea Roşie a vertebratelor din România*. Tipografia „Curtea Veche", Bucureşti.
4. CAZACU M., 2007- *Studii ecologice şi etologice asupra genului Chlidonias (Aves- Ord. Charadriiformes, familia Sternidae) din bazinul inferior românesc al Prutului*. Rezumat teză de doctorat, Univ. „Al. I. Cuza" Iaşi
5. GACHE C., 2002- *Dinamica avifaunei din bazinul râului Prut*. Publ. S.O.R., 15, Cluj Napoca.
6. ION I., GACHE C., 1992- *Observations sur la dispersion zonale de l'avifaune du basin de la Riviere Prut*. Anal. Şt. Ale Univ. „Al. I. Cuza", Iaşi, s. Biol. Anim., T. XXXVIII: 163-166.
7. MATEI D., MISĂILĂ E. R., IRIMIA D., 1999- *Program naţional de cercetări ihtiologice în bazinele hidrografice ale României*, S.C.A.E.A., Iaşi.
8. POPA L., 1962- *Raspredelenie ihtiofauna r. Prut po uciatskom*. Zapiski KGUT 62, Vap. I., Chişinău
9. TOFAN-BURAC T., CHIFU, T., 2002- *Flora şi vegetaţia din Valea Prutului*. Edit. Corson, Iaşi
10. USATÂI M., CREPSIS O., BODEAN A., 1999- *Starea actuală a ihtiocenozei lacului de baraj Costeşti - Stânca*. Lucr. Simpoz. "Lacurile de acumulare din România", vol. 2, Edit. Univ. "Al. I. Cuza" Iaşi
11. ZAMFIRESCU ŞT., 2002 - *Studiul amfibienilor din bazinul mijlociu al Prutului*. Teză de doctorat, Univ., "Al. I. Cuza" Iaşi
12. ***, 1979- *Convention on the Conservation of European Wildlife and Natural Habitats* - (Bern Convention)
13. ***, 1992- Council Directive 92/43/EEC - *On the Conservation of Natural Habitats and of Wild Fauna and Flora* (Habitats Directive).

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EFFECT OF DIFFERENT PLANT EXTRACTS ON SOME VEGETABLE PESTS

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ABSTRACT

BRATU E., 2006 - Effect of different plant extracts on some vegetable pests. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 484-494.

Researches performed in laboratory or greenhouse conditions had as aim to establish the action potential of some alcoholic or acetone extracts obtained from 15 different plant species appertaining to genera *Chrysanthemum*, *Tanacetum*, *Berberis*, *Chelidonium*, *Inula*, *Ruta*, *Tagetes*, *Thuja*, *Echinacea*, *Abies*, *Pinus*, *Taxus* and *Sinapis*. Plant extracts having a determinate vegetal compounds content were tested against mites (*Tetranychus urticae*), white flies (*Trialeurodes vaporariorum*), potato Colorado beetles (*Leptinotarsa decemlineata*) and slugs (*Deroceras agreste*), which frequently attack the tomato, egg-plants, cucumber or lettuce crops in field or under greenhouse conditions. Extract water solutions in concentration of 5% were applied by pulverization on plant leaves. Action potential of plant extracts was quantified in mortality registered per each variant. A product based on *azadirachtin* (0,3 % a.i.) was used as check control. Obtained results emphasized the high potential and large action spectrum of azadirachtin, which induced mortalities between 83,3 – 100 % to all target-pests, as well as of the alcoholic extracts of *Thuja* (62,5-100 %), *Sinapis* (56,7-100 %), *Abies* (53,0-100 %) and *Echinacea* (50,0-79,4 %). Alcoholic extracts obtained from two species of *Chrysanthemum* have determined mortalities varying 61,6-100 % and 50,0-100% at *T.urticae*, *L.decemlineata* and *D. agreste*, while that in acetone of *Abies* provided mortalities of 75,0-98,1 % at *T.urticae*, *T.vaporariorum* and *L.decemlineata* pests. *Tanacetum*, *Berberis*, *Chelidonium*, *Inula*, *Ruta* and *Taxus* extracts induced mortalities varying between 50,0 – 100%, at one or two target-pests, only and *Tagetes* extract provided the best result against *T.urticae* (56,3 %) at 18-21°C.

Key words: plant extracts, pests, vegetables, mortality, greenhouse.

Introduction

Althouth balanced, repellent or toxical effects of different plants products were signaled long time ago, being empirical used in agricultural practices, after chemical pesticides appearance and during the whole period of its supremacy, the plant metabolites properties were ignored or less investigated.

Enviromental pollution stressing in the last two decade, and the necesity to reduce the damages caused by irrational chemical pesticides application for more than 60 years, scientists reminded of this vaste investigation field.

As follow, researches concerning to the possibility of using the secondary plant metabolites in the control of differents agricultural pests had known a big development in the last few years. Many countries (India, China, Koreea, Pakistan, Iran, Japan, etc.), with a long and impresive tradition in regard to botanical resources using for therapeuthical scopes, as well as the countries from Central and South America recognized for the spontaneous flora wealth and diversity,had extended their reasearches on this way.

Performed investigations on different categories of target-organisms showed that some botanical species manifested a separate action against pathogens and pests, controling either one or many species from respective categories, while the other presented a mixed action, including in the target-organisms spectrum both pathogen and pest species.

This paper presented the obtained results under laboratory and greenhouse conditions as regards the potential, efficacy and action spectrum of 15 different plant species tested against few important vegetable pests (*Trialeurodes vaporariorum* Westw., *Tetranychus urticae* Koch., *Leptinotarsa decemlineata* Say., *Deroceras agreste* L.).

Materials and methods

Experiments' concerning the plant extracts efficacy against different vegetable pest species (*Trialeurodes vaporariorum* Westw., *Tetranychus*

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urticae Koch., *Leptinotarsa decemlineata* Say., *Deroceras agreste* L.) were performed on tomatoes, egg-plants, cucumbers and lettuce, under laboratory or greenhouse conditions. It were tested 28 plant extracts obtained from 15 different species (*Chrysanthemum balsamita, Ch. parthenium, Ch. cinerariifolium, Tanacetum vulgare, Berberis vulgaris, Chelidonium majus, Inula helenium, Ruta graveolens, Tagetes erecta, Thuja occidentalis, Echinacea purpurea, Abies alba, Pinus sylvestris, Taxus baccata, Sinapis alba*). A detailed description of experimental variants is presented in table 1. A product based on *Azadirachta indica* (azadirachtin 0, 3 %) was used as check control.

Experiments under laboratory conditions

Plant extracts efficacy was tested against *L. decemlineata* and *D. agreste* larva.

Leptinotarsa decemlineata (potato Colorado beetle)

In experiment were used larvae of 1^{st}, 2^{nd} and 3^{rd} developmental stage, collected from field egg-plant crops. Pest larvas were introduced in Petri dishes (Ø 180 mm) together 2-3 egg-plant leaves as food. Each Petri dish contained 8 larvas in different stage. They were treated together with egg-plant leaves by spraying of plant extracts water solutions (conc. 5%). Finally, experiment dishes were covered with textile material (gauze) for aeration. Pest larva consumed treated leaves during 2 days, after that they being feed with fresh untreated leaves. Experimental period was of 52 days. Larvas were monitorized until the end of metamorphosis and the last adult retract to hibernation. In this scope, at the end of larval development, some soil (3 cm) was introduced inside of Petri dishes.

Experiment was performed at temperatures varying between 25-28^{o}C and relative humidity of 60-70%, being organized in 24 variants with 3 replications. After 20 days from the hibernation retract of the last adult, soil was checked in order to survivor adults collecting and counting.

Daily observations, made in the same time with insects feeding, registered the number of death individuals. Registered data were used to establish the mortality percentage per each experimental variant.

Deroceras agreste (garden slug)

Young pest larva (the first 3-4 stages of developmental cycle) were collected from environmental medium and kept 24 hours in a cage at room temperature. After that slugs were distributed in Petri dishes (Ø 180 mm) containing 1 cm soil stratum, those surface was moisture by spraying of 25 ml drinkable water. Each Petri dish contained 5 slugs in different developmental stages and 2-3 lettuce leaves offered as food. Water solutions of plant extracts (conc. 5%) were sprayed on the soil and leaves surface, in order to assure a relative high level of soil imbibitions. Some lettuce pots plants were also sprayed with tested plant extracts to provide the slugs' food-source during the experimentation period.

Each Petri dish was covered with gauze and, all together with a plastic material having as role the moisture maintain and creating of a microclimate similar those of the natural pest habitat. Slugs were daily feed with treated lettuce leaves.

Experiment was developed at temperature varying between 18-20^{o}C and a relative air humidity of 75-85%, being organized in 27 variants with 5 replications.

Daily observations registered the dead slugs' number per variant.

Experiments under greenhouse conditions

Experiments under greenhouse conditions were performed on vegetable seedlings and/or crops, natural infested with mites (*T. urticae*) and white flies (*T. vaporariorum*), or artificial infested in the case of garden slugs (*D. agreste*).

Trialeurodes vaporariorum (white fly) and ***Tetranychus urticae*** (common red mite)

In the first case, plant extracts efficacy against the two target-pests was tested on egg-plant seedlings pots in the stage of 7-8 truth leaves. Extracts applied by foliar spraying were used at a concentration of 5%. Untreated and treated egg-plant seedlings with *azadirachtin* (conc. 0, 3 %) were used for control.

Experiments developed under low and middle infestation levels of white flies and mites, respectively were organized in 21 and 22 variants with 6 replications.

Temperature varied between 19-35^{o}C, and relative air humidity between 80-90% during experimentation period.

Periodical determination performed during of 13 days period had as aim the registration of live and dead white flies pupa and mobile mite's stages number/cm^2. Data were used to quantify the plant extracts potential of reduction by pests' mortality percentage.

In the second case, other two experiments were organized on cucumbers and tomatoes crops in blossoming-fruition stage. Mites monitoring was performed on cucumbers, while the white flies were supervised on both crops, according to experimental variants presented in table 1. Plant extracts were applied in water solutions (conc. 5%) by foliar spraying, at temperatures varying between 25-30^{o}C and relative air humidity of 60-65%, but during the experimentation period were registered temperatures over 35^{o}C.

Observations performed at 1, 3, 6, 9 and 13 days after treatment had in the view registration of live and dead pests / cm^2, data being used to establish the extracts efficacy based on resulted mortality percentage.

Deroceras agreste (garden slug)

Verifying of some extracts efficacy against garden slugs was realized on a lettuce crop artificial infested. Slugs collected from field were uniformly distributed on lettuce plants (1 snail/plant). Experiment was organized in 6 variants disposed in line, on a surface of 30 m^2. Treatments were applied 24 hours after infestation according to the variants presented in table 1.

After extracts application the lettuce crop was covered with black polyethylene in order to increase the temperature, maintain of soil moisture and reduce the evaporation of plant extracts volatile compounds.

First observation performed before of extracts application and the follows at interval of 3 and 6 days after treatment registered the attacked plants number, as well as the live and dead slugs' number per each variant. Data were used to establish the density reduction compare to untreated control and treated control (*azadirachtin* – conc. 3 %).

Results and discussions

Experiments under laboratory conditions

<u>Leptinotarsa decemlineata</u>

Trials performed for emphasizing of plant extracts efficacy against Colorado beetle larva in the 1st, 2nd and 3rd developmental stages (table 2), showed that:

➔ **in larval stage:**

➢ <u>against young larva (stages I - II):</u>

- *azadirachtin* was very toxic inducing the maximum mortality level (100%), after 24 hours of treatment application;
- extracts EV-01Aa and EV-13B had a lower efficacy than *azadirachtin*, however providing mortalities ≥ 50%;
- at all the others extracts which induced mortalities under 50%, survivor larva continued developmental cycle, their mortality happening in the metamorphosis advanced stages;

➢ <u>against mature larva (stages III - IV):</u>

- extracts EV-03A, EV-09A and EV-10A proved the highest efficacy, inducing a pest mortality of 100 %;
- relative lower mortality levels, but higher than 50%, registered the extracts EV-01A and EV-13B;

➔ **in pupa stage:**

- EV-13A, EV-09A, EV-13B and EV-14B provided mortalities ≥ 50% ;

➔ **in adult stage:**

- extracts efficacy, quantified by the mortality percentage registered at the end of pest metamorphosis, demonstrated that: *azadirachtin* was the most toxic extract (100%), being followed in decreasing order of EV-13A, EV-13B, EV-16A > EV-09A, EV-14A > EV-01Aa, EV-03Aa, EV-10A and EV-14B, which determined mortalities between 50 and 75%;
- all the other extracts induced mortality values lower than 50%;

Relative high mortality of untreated larva (37, 5 %) was due to placement of untreated and treated check control very near each other, this fact demonstrating the strong insecticidal effect of *azadirachtin* amplified by the volatile compounds action, also.

<u>Deroceras agreste</u>

Obtained results had demonstrated the strong moluscicide action of extracts EV-01Aa, EV-06A, EV-09A, EV-12A, EV-16A and *azadirachtin*, which manifesting a very high toxicity compare to untreated control. Extracts EV-02Aa, EV-03Aa, EV-07A, EV-13A and EV-16Aa provided good results also, inducing pests' mortality in proportion of 80 %, while EV-10A and EV-15A determined lower mortality values, however surpassing 50 %.

Was remarked that:

- all these 12 extracts which gave good results in the laboratory conditions were alcoholic extracts;
- except EV-02Aa, EV- 03Aa and EV-16A extracts, all the others induced the maximum mortality values in the first 3 days after treatment application.

Experiments under greenhouse conditions

<u>Trialeurodes vaporariorum</u>* and *<u>Tetranychus urticae</u>

Experiments performed on egg-plant seedlings in order to emphasize plant extracts efficacy against white fly and common red mite provided the results presented in tables 4 and 5.

General data analysis showed that *T. vaporariorum* pupa mortality (table 4) varied between 0 – 85,7 %, alcoholic extracts EV-15A, EV-01A, EV-03A, EV-07A and EV-13A, obtained from *Taxus baccata*, *Chrysanthemum balsamita*, *Tanacetum vulgare* var. *crispum*, *Ruta graveolens* and *Pinus sylvestris*, respectively emphasizing values ≥ 50 %.

However, was observed that treated pupa didn't present the evident modifications as follow of extracts action, their morphological features and color remaining relative unchanged. In this case, mortality determination taken into account the easy darkened of pupa color.

In case of *T. urticae*, although mite larva and adults kept their specific color after treatment, most part of observed individuals lost the mobility, becoming inactive. In some cases, mites body was more convex with a fissured cuticle, which broken at the touch, eliminating interstitial liquid. This effect suggests the plant extracts implication in the perturbation of insects' growth and development processes.

Analysis of data presented in table 5, emphasized 6 different trajectories type (A, B, C, D, E and F) of plant extracts efficacy dynamics during the experimentation period. Different plant extracts behavior suggested some hypothetical explanations. Thus:

A. This behavior type could be due to the strong and persistent insecticidal action of the extracts EV-03A, EV-10A and EV-13B, its effect manifesting on mite eggs also, that contributing to progressive reducing of mites number;
B. Such behavior can be the result of relative short extracts persistence on leaves (*azadirachtin*, EV-01A, EV-09A, EV-15B and EV-16A), caused by plant compounds inactivation or perishing under high temperatures and/or light action;
C. Extract EV-09B revealed a reduced efficacy values and a short action period, explained by the rapid evaporation of the solvent (acetone), which proved a relative high acaricidal potential (aprox. 50%) in other experiments;
D. This curve type suggests a relative slow but strong extracts EV-02A, EV-06B and EV-12A effect against mobile pest stages, lack of ovicidal action (hatched egg contributed to extracts efficacy reducing after 6 days), as well as its persistence on leaves, which induced more or less significant mortality increases, after 13 days;
E. Mortality dynamics in the case of EV-04A, EV-05A, EV-07A, EV-08A, EV-13A, EV-14A and EV-15A extracts revealed the relative rapid and strong extracts effect, very short time after treatment, lack of ovicidal action and long persistence on leaves;
F. Despite of the resemblance between this curve and E type, these plant extracts (EV-06A and EV-14B) had a shorter persistence on leaves.

Results obtained against the two pest species (*T. vaporariorum* and *T. urticae*) on cucumbers and tomatoes crops are presented in tables 6 and 7.

Some general aspects were noticed:

- presence on the cucumber plants of many pests species, competitor at the same food source determined reducing of white flies infestation and their migration on tomatoes crop placed in the vicinity of cucumber crop;
- relative reduced efficacy of the most plant extracts was due of its exposing at high temperatures during the experimentation period.

Data presented in table 6 emphasized the installation periods of plant extracts efficacy action. Thus, under mentioned experimental conditions, EV-09A attained the highest efficacy value after 6 days of treatment, while EV-10A, EV-13A, EV-13B and EV-15B registered the best efficacy after 13 days, and EV-09B, EV-12A, EV-15A, EV-15Aa and EV-16A, 20 days later.

Having in the view that lethal effect prevalent was observed at young white fly's larva and less at mature nymphs, it appreciate some extracts could have an insect growth inhibitory action.

Under high natural infestation of cucumbers crop, plant extracts efficacy against red common mites (table 7) varied between 8, 3-100 % (after 24 h), and 9, 1-89, 2 % (after 9 days).

Extracts EV-15B, EV-13B, EV-10Aa, EV-16A (> 90-100%), *azadirachtin* (> 80%), EV-15Aa (> 70%) gave the best results after 24 hours, all the others registering efficacy values under 70%.

Despite of general mortality level decreasing, it was observed that some extracts (EV-10Aa, EV-15Aa, EV-13B) kept its high efficacy values (> 70%), other extracts provided a more or less increased efficacy (EV-02Aa, EV-03A, EV-04A, EV-09A, EV-09B, EV-10A, EV-12A, EV-14A, EV-14B, EV-16Aa), while the remainder extracts registered a more or less decreasing of its efficacy values, 9 days after treatments.

Obtained results suggest an ovicidal action of plant extracts which increased its efficacy during the observation period, that could be was amplified by the pest exposure at high temperatures.

<u>Deroceras agreste</u>

Verifying of some plant extracts efficacy against garden slugs on an artificial infested lettuce crop provided the results presented in table 8.

Registered data demonstrated the relative high control potential of *azadirachtin* and EV-01Aa extract. Even if the pest mortality was low because of slugs' soil retraction during the day, it was observed that many of them migrated from EV-01Aa and *azadirachtin* treated plants to treated plants of the other variants, nearly placed. This observation suggests a possible repellent action of the two plant extracts.

A detailed action spectrum of experimented plant extracts is presented in table 9.

Conclusions

<u>In laboratory conditions</u>

- alcoholic extracts EV-01Aa (*Chrysanthemum balsamita*), EV-06A (*Inula helenium*), EV-09A (*Thuja occidentalis*), EV-12A (*Chrysanthemum cinerariifolium*) and EV-16A (*Sinapis alba*) used against ***Deroceras agreste*** slugs provided the highest efficacy values (100%), comparable to the treated control (*azadirachtin*); good result were obtained also with EV-02Aa (*Chrysanthemum parthenium*), EV-03Aa (*Tanacetum vulgare* var. *crispum*), EV-07A (*Ruta graveolens*) and EV-13A (*Abies alba*) which induced slugs mortality in proportions of 80%;
- ***L. decemlineata*** mortality registered after metamorphosis finalization was comprised between 25-100%, varying in decreasing order from *azadirachtin* (100%) > EV-13A (*Abides alba*-alcohol), EV-13B (*Abies alba*-acetone), EV-16A (*Sinapis alba*) > EV-09A (*Thuja occidentalis*), EV-14A (*Pinus sylvestris*-alcohol) > EV-01Aa (*Chrysanthemum balsamita*), EV-03Aa (*Tanacetum vulgare* var.*crispum*), EV-10A (*Echinacea purpurea*), and EV-14B (*Pinus sylvestris*-acetone) (50-75 %) > remainded extracts (< 50%);

<u>Under greenhouse conditions</u>

- on **egg-plant** seedlings infested of *T. vaporariorum* and *T. urticae* EV-15A (*Taxus baccata* -acetone), induced both pest mortality in proportions of 85,7% and 61,1%, resp., while *azadirachtin*, EV-01A (*Ch. balsamita*), EV-03A (*T. vulgare*), EV-07A (*R. graveolens*) and EV-13A (*A. alba*-alcohol) provided lower efficacy values (50-71,4%) against *T. vaporariorum*, and EV-14B (*P. sylvestris*), EV-13B (*A. alba*-acetone), EV-13A (*A. alba*-alcohol), EV-05A (*Chelidonium majus*), EV-12A (*Ch. cinerariifolium*), EV-02A (*Ch. parthenium*) and EV-04A (*Berberis vulgaris*) determined relative higher mortality values (66,7-77,8%) of *T. urticae*;
- on **cucumbers** crop the best results against *T. urticae* pest were obtained with EV-10Aa (*E. purpurea*), EV-15Aa (*T. baccata*) and EV-13B (*A. alba*-acetone), which kept its efficacy values at relative high level (79,4-89,2%) until to 9 days after treatment, while *azadirachtin* registered the highest mortality (89,5%) after 24 hours, and EV-02Aa (*Ch. parthenium*), EV-03A (*T. vulgare*), EV-04A (*B. vulgaris*), EV-09A (*T. occidentalis*-alcohol), EV-09B (*T. occidentalis*-acetone), EV-10A (*E. purpurea*), EV-12A (*Ch. cinerariifolium*), EV-14A (*P. sylvestris*-alcohol), EV-14B (*P. sylvestris*-acetone) and EV-16Aa (*S. alba*) after 9 days (50-85%); also, *azadirachtin* and EV-05A (*Chelidonium majus*) determined *T. vaporariorum* mortalities of 83,3 % and 50%, resp.;
- on **tomatoes** crop the highest efficacy values (71,8%; 79,5%; 76,5%) obtained against *T. vaporariorum* were registered at EV-09A (*T. occidentalis*-alcohol) after 6 days, EV-13B (*A. alba*-acetone) after 13 days, and EV-12A (*Ch. cinerariifolium*) after 20 days of treatment, resp.;
- on lettuce crop *azadirachtin* and EV-01Aa (*Ch. balsamita*) assured a density reduction with 86,5% and 70,3% of *Deroceras agreste* slug, 3 days after treatment;
- *azadirachtin*, EV-09A (*T. occidentalis*-alcohol), EV-10A (*E. purpurea*), EV-13A (*A. alba*-alcohol) and EV-16A (*S. alba*) had the most large action spectrum, assuring a relative good control of all the pest species taken into account; alcoholic extracts obtained from *Ch. balsamita*, *Ch. cinerariifolium*, R. *graveolens* and *T. baccata*, as well as the *A. alba* acetone extract had a lower action spectrum, each of its controlling only 3 pest species.

References

1. METSPALU L., HIIESAAR K., JÕUDU J., KUUSIK A., 2001- The effects of certain toxic plant extracts on the larvae of Colorado potato beetle, *Leptinotarsa decemlineata* (Say.). In Practice oriented results on the use of plant extracts and pheromones in pest control: Proceedings of the International Workshop, Tartu, Estonia, 24-25 January, 2001, 84-89 ISBN 9985-9318-3-1. (Estonia)
2. OUDHIA P., 2001 - Traditional medicinal knowledge about pod borer *Helicoverpa armigera* in Chhattisgard, India. *International Chickpea and Pigeonpea Newsletter* No.8, 14-15
3. PATNAIK N.C., TRIPATHY M.K., 2001 - Incidence and management of the garden slug, *Laevicaulis alte* Ferrusac in Orissa. Journal of Applied Zoological Researches 12 (1) 57-58.
4. PANDEY N.D., SINGH L., SINGH Y.P., TRIPATHI R.A., 1988 - Effect of certain extracts against *Lipaphis erysimi* Kalt. under laboratory conditions. Indian Journal of Entomology, 49 (2) 238-242 (India).

Table 1. Description of experimental variants

Extract code	Plant-source	Organs	Physical properties	Solvent	Ratio (plant material /solvent)	Content of plant compounds (g/100 ml product)	Plant extracts tested against some vegetable target-pests under different conditions							
							Greenhouse						Laboratory	
							T. vaporariorum			*T. urticae*		*D. agreste*	*D. agreste*	*L. decemlineata*
							Egg-plants	Cucumbers	Tomatoes	Egg-plants	Cucumbers	Lettuce	Lettuce	Egg-plants
Mn	Untreated check control	-	-	-	-	-	*	*	*	*	*	*	*	*
M-Aza	*Azadirachtin* (treated control)	unknown	unknown	unknown	unknown	0,300	*	*	*	*	*	*	*	*
EV-01A	*Chrysanthemum balsamita*	Flowers	Dry	Alcohol	1:5	1,080	*	*		*	*		*	*
EV-01Aa		Flowers	Dry	Alcohol	1:5	4,320		*			*	*	*	*
EV-02A	*Chrysanthemum parthenium*	Flowers	Dry	Alcohol	1:5	1,440	*			*	*		*	*
EV-02Aa		Flowers	Dry	Alcohol	1:5	5,760		*			*		*	*
EV-03A	*Tanacetum vulgare*	Flowers	Dry	Alcohol	1:5	0,420	*			*	*		*	*
EV-03Aa		Flowers	Dry	Alcohol	1:5	1,680					*		*	*
EV-04A	*Berberis vulgaris*	Bark	Dry	Alcohol	1:5	0,440	*	*		*	*		*	*
EV-04Aa		Bark	Dry	Alcohol	1:5	1,760		*			*		*	*
EV-05A	*Chelidonium majus*	Leaf	Fresh	Alcohol	1:2	1,260	*	*		*	*		*	
EV-05Aa		Leaf	Fresh	Alcohol	1:2	5,040		*			*		*	
EV-06A	*Inula helenium*	Root	Fresh	Alcohol	1:2	6,260	*	*		*	*	*	*	
EV-06B		Root	Fresh	Acetone	1:2	8,100		*			*		*	*
EV-07A	*Ruta graveolens*	Leaf	Fresh	Alcohol	1:2	2,880	*	*		*	*		*	*
EV-08A	*Tagetes erecta*	Flowers	Fresh	Alcohol	1:2	2,180	*	*		*	*		*	
EV-09A	*Thuja occidentalis*	Twigs	Fresh	Alcohol	1:2	2,540	*		*	*	*	*	*	*
EV-09B		Twigs	Fresh	Acetone	1:2	2,400	*		*	*	*		*	*
EV-10A	*Echinacea purpurea*	Root	Dry	Alcohol	1:5	0,080	*		*	*	*		*	*
EV-10Aa		Root	Dry	Alcohol	1:5	0,640			*		*			
EV-12A	*Chrysanthemum cinerariaefolium*	Flowers	Dry	Alcohol	1:5	0,760	*		*	*	*		*	*
EV-13A	*Abies alba*	Leaf	Dry	Alcohol	1:5	1,660	*		*	*	*		*	*
EV-13B		Leaf	Dry	Acetone	1:5	2,020	*		*	*	*		*	*
EV-14A	*Pinus sylvestris*	Leaf	Fresh	Alcohol	1:2	1,520	*		*	*	*		*	*
EV-14B		Leaf	Fresh	Acetone	1:2	2,820	*		*	*	*		*	*
EV-15A	*Taxus baccata*	Leaf	Fresh	Alcohol	1:2	1,400	*		*	*	*		*	*
EV-15Aa		Leaf	Fresh	Alcohol	1:2	2,800			*		*			
EV-15B		Leaf	Fresh	Acetone	1:2	2,400	*		*	*	*			
EV-16A	*Sinapis alba*	Seeds	Dry	Alcohol	1:5	0,760	*		*	*	*		*	*
EV-16Aa		Seeds	Dry	Alcohol	1:5	3,040			*		*	*	*	

Legend

Tested variants	*
Untested variants	

Tab. 2

Mortality of potato Colorado beetle (*Leptinotarsa decemlineata* Say.) larva during the development cycle												
Experimental variants	No. of young larva (stage I+II)		Mortality of young larva (%)	No. of mature larva (III)		Mortality of mature larva (%)	Larval mortality (%)	No. of pupated larva	Mortality in pupa stage (%)	No. of emerged adults		Mortality in the imago stage (%)
	Live initially	Dead		Live initially	Dead					Live	Dead	
Mn (untreated control)	7	2	28,6	1	0	0,0	25,0	6	16,7	5	0	37,5
M-Aza (treated control-*azadirachtin*)	8	8	100,0	0	0	0,0	100,0	0	-	-	-	100,0
EV-01A	5	0	0,0	3	2	66,7	25,0	6	0,0	6	0	25,0
EV-01Aa	7	4	57,1	1	0	0,0	50,0	4	0,0	4	0	50,0
EV-02A	6	0	0,0	2	0	0,0	0,0	8	12,5	7	0	12,5
EV-02Aa	5	0	0,0	3	1	33,3	12,5	7	14,3	6	0	25,0
EV-03A	7	1	14,3	1	0	0,0	12,5	7	0,0	7	0	12,5
EV-03Aa	7	0	0,0	1	1	100,0	12,5	7	42,9	4	0	50,0
EV-04A	6	2	33,3	2	0	0,0	25,0	6	0,0	6	0	25,5
EV-04Aa	7	1	14,3	1	0	0,0	12,5	7	14,3	6	0	25,5
EV-06B	6	1	16,7	2	0	0,0	12,5	7	0,0	7	0	12,5
EV-07A	7	3	42,9	1	0	0,0	37,5	5	0,0	5	0	37,5
EV-09A	7	1	14,3	1	1	100,0	25,5	6	50,0	3	0	62,5
EV-10A	7	1	14,3	1	1	100,0	25,5	6	33,3	4	0	50,0
EV-12A	8	1	12,5	0	0	0,0	12,5	7	28,6	5	0	37,5
EV-13A	8	1	12,5	0	2	25,0	37,5	5	60,0	2	0	75,0
EV-13B	6	3	50,0	2	1	50,0	50,0	4	50,0	2	0	75,0
EV-14A	8	1	12,5	0	0	-	12,5	7	42,9	3	1	62,5
EV-14B	8	0	0,0	0	0	-	0,0	8	50,0	4	0	50,0
EV-15A	8	0	0,0	0	0	-	0,0	8	25,0	6	0	25,0
EV-16A	8	3	37,5	0	0	-	37,5	5	40,0	2	1	75,0

Legend

Mortality %	Color code
≥ 50-60	
> 60-70	
>70-80	
>80-90	
>90-100	

Table 3

Efficacy of plant extracts applied against slugs (*Deroceras agreste*) under laboratory conditions		
Experimental variants	Mortality (%)	
	3 days	10 days
Mn (untreated control)	0,0	0,0
M-Aza (treated control-*azadirachtin*)	100,0	-
EV – 01A	40,0	40,0
EV – 01Aa	100,0	-
EV – 02A	0,0	20,0
EV – 02Aa	80,0	80,0
EV – 03A	0,0	0,0
EV – 03Aa	60,0	80,0
EV – 04A	0,0	0,0
EV – 04Aa	0,0	0,0
EV – 05A	0,0	0,0
EV – 05Aa	0,0	0,0
EV – 06A	100,0	-
EV – 06B	40,0	40,0
EV – 07A	80,0	80,0
EV – 08A	20,0	20,0
EV – 09A	100,0	-
EV – 09B	0,0	0,0
EV – 10A	60,0	60,0
EV – 12A	100,0	-
EV – 13A	80,0	80,0
EV – 13B	0,0	20,0
EV – 14A	0,0	0,0
EV – 14B	0,0	20,0
EV – 15A	60,0	60,0
EV – 16A	60,0	100,0
EV – 16Aa	80,0	80,0

Legend

Mortality %	Color code
≥ 50-60	
> 60-70	
>70-80	
>80-90	
>90-100	

Table 4

Efficacy of plant extracts tested on egg-plants seedlings white fly infested (*Trialeurodes vaporariorum*) under greenhouse conditions (13 days after treatment)		
Experimental variants	Conc. (%)	Mortality (%)
Mn (untreated control)	-	0,0
M-Aza (treated control-*azadirachtin*)	1,5	71,4
EV-01A	5,0	52,0
EV-02A	5,0	33,3
EV-03A	5,0	50,0
EV-04A	5,0	25,0
EV-05A	5,0	0,0
EV-06A	5,0	0,0
EV-06B	5,0	6,7
EV-07A	5,0	50,0
EV-08A	5,0	20,0
EV-09A	5,0	8,3
EV-09B	5,0	36,4
EV-12A	5,0	0,0
EV-13A	5,0	50,0
EV-13B	5,0	28,6
EV-14A	5,0	7,7
EV-14B	5,0	19,0
EV-15A	5,0	85,7
EV-15B	5,0	28,6
EV-16A	5,0	14,3

Table 5

Efficacy of plant extracts applied on egg-plants seedlings mites (*Tetranychus urticae*) infested, under greenhouse conditions (13 days after treatment)					
Experimental variants	*Conc. (%)*	*Mortality (%)*			
		24 h	3 days	6 days	13 days
Mn (untreated control)	-	0,0	0,0	0,0	3,1
M-Aza (treated control* - azadirachtin*)	1,5	5,6	16,7	57,1	25,0
EV-01A	5,0	0,0	45,5	55,6	0,0
EV-02A	5,0	0,0	66,7	39,1	58,8
EV-03A	5,0	29,4	34,3	36,8	52,6
EV-04A	5,0	25,0	18,2	41,0	66,7
EV-05A	5,0	10,0	0,0	54,1	75,0
EV-06A	5,0	16,7	0,0	45,5	33,3
EV-06B	5,0	0,0	58,3	39,5	41,2
EV-07A	5,0	54,5	25,6	50,0	57,6
EV-08A	5,0	37,5	23,8	51,0	56,3
EV-09A	5,0	0,0	0,0	41,2	46,2
EV-09B	5,0	0,0	36,4	34,6	28,6
EV-10A	5,0	0,0	32,0	44,8	46,2
EV-12A	5,0	28,6	60,0	42,1	70,6
EV-13A	5,0	75,0	25,0	42,1	50,0
EV-13B	5,0	0,0	23,5	46,7	75,9
EV-14A	5,0	42,9	15,8	35,3	56,5
EV-14B	5,0	71,4	35,0	77,8	58,3
EV-15A	5,0	35,7	13,6	57,6	61,1
EV-15B	5,0	0,0	16,7	56,3	37,9
EV-16A	5,0	29,4	50,0	59,5	50,0

Legend

Mortality level (%)	Color code
≥ 50-60	
> 60-70	
> 70-80	
> 80-90	

Color code and curve type	Mortality variation trajectory			
A	↑	↑	↑	↑
B	↑	↑	↑	↓
C	↑	↑	↓	↓
D	↑	↑	↓	↑
E	↑	↓	↑	↑
F	↑	↓	↑	↓

Tab. 6

Efficacy of plant extracts tested in the white fly (*Trialeurodes vaporariorum*) control on cucumber and tomato greenhouse crops							
Experimental variants	Conc. (%)	Mortality (%)					
		Cucumbers		Tomatoes			
		24 h	9 days	24 h	6 days	13 days	20 days
Mn (untreated control)	-	6,0	0,0	2,3	12,4	27,1	20,9
M-Aza (treated control- *azadirachtin*)	3,0	12,5	83,3	-	-	-	-
EV-01A	5,0	16,7	22,2	-	-	-	-
EV-01Aa	5,0	12,5	33,3	-	-	-	-
EV-02A	5,0	33,3	-	-	-	-	-
EV-02Aa	5,0	14,3	0,0	-	-	-	-
EV-03A	5,0	-	-	-	-	-	-
EV-03Aa	5,0	33,3	-	-	-	-	-
EV- 04A	5,0	20,0	0,0	-	-	-	-
EV-04Aa	5,0	16,7	0,0	-	-	-	-
EV-05A	5,0	41,2	50,0	-	-	-	-
EV-05Aa	5,0	7,7	21,7	-	-	-	-
EV-06A	5,0	-	0,0	-	-	-	-
EV-06B	5,0	16,7	20,0	-	-	-	-
EV-07A	5,0	38,5	0,0	-	-	-	-
EV-08A	5,0	-	0,0	-	-	-	-
EV-09A	5,0	-	-	2,5	71,8	36,5	49,7
EV-09B	5,0	-	-	4,8	11,0	30,4	60,7
EV-10A	5,0	-	-	6,9	39,6	58,1	54,3
EV-10Aa	5,0	-	-	19,5	19,0	34,9	48,7
EV-12A	5,0	-	-	34,5	31,6	45,3	76,5

EV-13A	5,0	-	-	23,8	27,3	62,5	58,3
EV-13B	5,0	-	-	25,9	55,9	79,5	50,0
EV-14A	5,0	-	-	26,9	25,5	33,3	42,2
EV-14B	5,0	-	-	13,9	28,6	46,7	45,2
EV-15A	5,0	-	-	7,8	19,2	29,2	65,2
EV-15Aa	5,0	-	-	11,8	33,1	57,6	70,0
EV-15B	5,0	-	-	13,0	27,6	58,2	34,8
EV-16A	5,0	-	-	6,3	13,4	31,1	56,7
EV-16Aa	5,0	-	-	0,9	27,6	43,5	28,3

Legend

Mortality %	Color code
≥ 50-60	
> 60-70	
>70-80	
>80-90	

Tab. 7

Efficacy of plant extracts applied against red common mites (*Tetranychus urticae*) on cucumber greenhouse crop

Experimental variants	Conc. (%)	Mortality (%)	
		24 h	9 days
Mn (untreated control)	-	0,0	0,0
M-Aza (treated control - *azadirachtin*)	3,0	89,5	42,7
EV-01A	5,0	55,2	44,1
EV-01Aa	5,0	68,0	40,3
EV-02A	5,0	33,8	22,6
EV-02Aa	5,0	41,2	50,0
EV-03A	5,0	52,2	53,0
EV-03Aa	5,0	43,4	9,1
EV- 04A	5,0	25,6	62,8
EV-04Aa	5,0	38,1	37,8
EV-05A	5,0	30,0	36,5
EV-05Aa	5,0	11,8	47,0
EV-06A	5,0	57,0	40,3
EV-06B	5,0	24,7	23,1
EV-07A	5,0	65,6	26,1
EV-08A	5,0	8,3	43,1
EV-09A	5,0	55,2	72,0
EV-09B	5,0	46,0	85,0
EV-10A	5,0	60,6	79,4
EV-10Aa	5,0	100,0	84,1
EV-12A	5,0	57,1	61,6
EV-13A	5,0	53,0	47,5
EV-13B	5,0	98,1	79,4
EV-14A	5,0	33,3	78,3
EV-14B	5,0	45,1	75,0
EV-15A	5,0	37,4	43,7
EV-15Aa	5,0	76,7	89,2
EV-15B	5,0	91,7	55,6
EV-16A	5,0	100,0	9,1
EV-16Aa	5,0	29,9	85,7

Legend

Mortality %	Color code
≥ 50-60	
> 60-70	
>70-80	
>80-90	
>90-100	

Tab. 8

Efficacy of plant extracts applied in the control of slugs (*Deroceras agreste*) on lettuce greenhouse crops								
Experimental variants	Conc. (%)	Frequency of attacked plants (%)			Mortality (%)		Reducing pest density (%)	
		Before of treatment	After treatment					
			3 days	6 days	3 days	6 days	3 days	6 days
Mn (untreated control)	-	70,0	90,0	100,0	2,6	0,0	-	-
M-Aza (treated control-*azadirachtin*)	3,0	78,9	89,5	52,6	16,7	0,0	86,5	85,3
EV-01Aa	5,0	80,0	100,0	100,0	0,0	0,0	70,3	44,1
EV-06A	5,0	19,0	66,7	100,0	0,0	0,0	13,5	29,4
EV-09A	5,0	72,7	95,5	68,2	4,5	4,0	40,5	26,5
EV-16Aa	5,0	68,2	59,1	100,0	0,0	0,0	48,6	47,1

Legend

Pest density reduction %	Color code
≥ 50-60	
> 60-70	
>70-80	
>80-90	

Tab. 9

Efficacy and action spectrum of plant extracts tested on different target-pests of tomato, cucumber, egg-plants and lettuce crops									
Variants	No. of target-pests controlled with efficacy > 50%	Efficacy (%)							
		Greenhouse						Laboratory	
		T. urticae		*T. vaporariorum*			*D. agreste*	*L.decemlineata*	*D. agreste*
		Cucumber	Egg-plant	Cucumber	Tomato	Egg-plant	Lettuce	Egg-plant	Lettuce
M-Aza	4	89,5	57,1	83,3	-	71,4	86,5		100,0
EV-01A	3	55,2	55,6	22,2	-	52,0	70,3	25,0	40,0
EV-01Aa	3	68,0	-	33,3	-	-	-	50,0	100,0
EV-02A	1	33,8	66,7	33,3	-	33,3	-	12,5	20,0
EV-02Aa	2	50,0	-	14,3	-	-	-	25,0	80,0
EV-03A	2	53,0	52,6	-	-	50,0	-	12,5	0,0
EV-03Aa	2	43,4	-	33,3	-	-	-	50,0	80,0
EV- 04A	1	62,8	66,7	20,0	-	25,0	-	25,5	0,0
EV-04Aa	0	38,1	-	16,7	-	-	-	25,5	0,0
EV-05A	2	36,5	75,0	50,0	-	0,0	-	-	0,0
EV-05Aa	1	47,0	-	21,7	-	-	-	-	0,0
EV-06A	2	57,0	45,5	0,0	-	0,0	13,5	-	100,0
EV-06B	1	24,7	58,3	20,0	-	6,7	-	12,5	40,0
EV-07A	3	65,6	57,6	38,5	-	50,0	-	37,5	80,0
EV-08A	1	43,1	56,3	0,0	-	20,0	-	-	20,0
EV-09A	4	72,0	46,2	-	71,8	8,3	40,5	62,5	100,0
EV-09B	2	85,0	36,4	-	60,7	36,4	-	-	0,0
EV-10A	4	79,4	46,2	-	58,1	-	-	50,0	60,0
EV-10Aa	1	100,0	-	-	48,7	-	-	-	-
EV-12A	3	61,6	70,6	-	76,5	0,0	-	37,5	100,0
EV-13A	4	53,0	75,0	-	62,5	50,0	-	75,0	80,0
EV-13B	3	98,1	75,9	-	79,5	28,6	-	75,0	20,0
EV-14A	2	78,3	56,5	-	42,2	7,7	-	62,5	0,0
EV-14B	2	75,0	77,8	-	46,7	19,0	-	50,0	20,0
EV-15A	3	43,7	61,1	-	65,2	85,7	-	25,0	60,0
EV-15Aa	2	89,2	-	-	70,0	-	-	-	-
EV-15B	2	91,7	56,3	-	58,2	28,6	-	-	-
EV-16A	4	100,0	59,5	-	56,7	14,3	48,6	75,0	100,0
EV-16Aa	2	85,7	-	-	43,5	-	-	-	80,0

Legend

Mortality %	Color code
≥ 50-60	
> 60-70	
>70-80	
>80-90	
>90-100	

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 495 – 501

PARASITOID ASSEMBLAGES OF THE DEFOLIATOR NOCTUIDAE SPECIES IN CABBAGE CROPS

GABRIELA PATRICHE*

ABSTRACT

PATRICHE G., 2006 - Parasitoid assemblages of the defoliator Noctuidae species in cabbage crops. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 495-501.

The paper presents the complex of parasitoid and hyperparasitoid species active amidst the populations of the three Noctuidae species (*Mamestra brassicae* L., *Autographa gamma* L. and *Helicoverpa armigera* Hbn.), defoliators in cabbage crops in South-Eastern Romania. It was identified five primary parasitoid species and one secondary parasitoid species for the period 1998-2001 for the defoliator *Mamestra brassicae*. Refering to *Autographa gamma* it was identified four primary parasitoid species and only one parasitoid species limited *Helicoverpa armigera*. *M. brassicae* was a characteristic species for the cabbage crops on studied area and it was efficiently limited at the eggs level by the *Trichogramma evanescens* Westwood, 1833. *Euplectrus cacoeciae* Ferrière played the major role at the larvae level. *Euplectrus cacoeciae* is recorded for the first time as parasite on *Mamestra brassicae* and *M. brassicae* - *Macrocentrus collaris* (Spinola 1808) is host-parasitoid relationship new for Romania.

Percent parasitism may be measured with reference to the density of host population on which it is acting. The population dynamics and the indexes of the frequency, abundance, dominance and index of ecological significance of the primary parasitoid were analyzed.

Key words: Noctuidae, cabbage, host-parasitoid relationships

Introduction

Mamestra brassicae L., among the Noctuidae species, represents one of the main defoliator species of the cabbage crops, along with *Plutella xylostella* L. (Lepidoptera: Plutellidae), *Pieris brassicae* L. şi *Pieris rapae* L. (Lepidoptera: Pieridae). *Autographa gamma* (Linnaeus, 1758) (Lepidoptera: Noctuidae), is a poliphagous species and she damage it produces on the cabbage is insignificant, as well as *Helicoverpa armigera* (Hubner, 1808) (Lepidoptera: Noctuidae), which can be met only sporadically (Manolache et al., 1969; Perju, 1995; Costea (Patriche), 2003).

The international scientific literature cites a great number (over 60 species) of parasitoids of the *Mamestra brassicae* eggs, larvae and pupae, over 60 species for *Autographa gamma* and over 45 species for *Helicoverpa armigera* (Aubert, 1978; Atanasov et al., 1981; Velicani et al., 1982; Taliţkii & Kusliţkii, 1990; Tobias et.al., 1995). In our country there were mentioned parasitoid species for *M. brassicae*, as well. However there were little remarks regarding their efficiency in limiting on a natural way of the defoliating Noctuidae (Constantineanu, 1959; Mustaţă, 1973; Perju et al., 1989; Pisică, 2001).

This work presents the role of the Noctuidae's parasitoid assemblages on the cabbage crops in South-Eastern Romania for the period 1998-2001, under the given circumstances of *Mamestra brassicae* having two generations of larvae a year, in the studied region (Ionescu, 1961; Ionescu, C.& Paşol, P., 1987; Patriche, 2005) and as a result the larvae can cause great damage. Moreover, the usage on a large scale of the pesticides, in the last decades, destroyed not only the defoliators but the predators and parasitoids, as well.

Material and methods

The research on the parasitoid assemblages which act Lepidoptera population, defoliator in the cabbage crops from South-Eastern of Romania took place between 1998-2001, in a number of 33 stations and 54 collection data (Fig. 1). Among these, in 22 stations (31 collection data) it has been identified *Mamestra brassicae* species, in 11 stations (18 collection data) *Autographa gamma* species and in 9 stations (13 collection data) it has been identified *Helicoverpa armigera*.

* Natural Sciences Museum Complex of Galati

Quantitative samples of eggs, larvae and pupae from Noctuidae species, found on plants were collected and reared in the laboratory (Shaw, 1997) for the emergence of moth or parasitoid individuals. Larvae were fed with fresh cabbage leaves and the pupae were kept in boxes. Most data on parasitism of *Mamestra brassicae* populations are qualitative quantified in order to present the relationship between parasitism and pest density, which may be compared with patterns from other sites.

For Noctuidae species, the abundance and the relationship with the other Lepidoptera populations, pest of cabbage crops and for parasitoid species, the abundance, the constancy, the dominance and the index of ecological significance are analyzed.

Identifications of parasitoid species were made by Dr. Gh. Mustata and Dr C. Pisica (Ichneumonidae), Dr. I. Andriescu for chalcidoid species and tachinids by Dr. H.P. Tschorsnig. Braconids species were identified together with Dr. A. Lozan (Costea *et. al*., 2002).

Results and discussions

Unlike the other identified defoliating species of Lepidoptera - *Pieris brassicae* Linné, 1758, *Pieris rapae* Linné, 1758 (Pieridae), *Plutella xylostella* Linné, 1758 (Plutellidae), the Noctuidae damage haven't had a peak in neither year. A stronger attack, especially of the *Mamestra brassicae*, was signaled in the first two years of research while in years 2000 and 2001 their damage was quite insignificant.

The effectivenes of the primary parasitoid manifested at the *M. brassicae* and *A. gamma* eggs level and the limitation of tha larvae stage was reduced, generally. Among the 5261 of the *M. brassicae* eggs*,* deriving from a number of 109 collected clutches, in 1998, it was parasitized 63,5% by *Trichogramma evanescens* Westwood, 1833 (Trichogrammatidae) (Table 1). For *A. gamma* parasitation at the eggs stage by *T. evanescens*, in the same year, was of 38,4% (Table 1).

Concerning the intervention of the parasitoid specie sat the *Mamestra brassicae* larval stage, this decreased throughout the four years. So as reported to the small number of the *M. brassicae* population compared with the other prezent Lepidoptera population, i tis to be pointed aut a medium effect of the parasitoid assemblage (Table2, Fig. 2). Because the *M. brassicae* is a characteristic species of the cabbage crops (Patriche, 2005), the relationship between the larval density on the plant and the parasitism percentage of the larvae and pupae was analized for this species. In 1998, the average larval density on planta t a station, was of 1.8, given the fact that in that year it was recorded the greatest parasitism percentage – 51,5% (Fig. 3). The same happened the next year when it was noted a balance between the average larval density on plant (maximum 2.5) and the parasitism procentage (peaks of 50 – 70,8%)**.** In year 2000 it was recorded the greatest density of 7,7 larvae on plant (Ieşire Galaţi – 24. 10. 2000 - station) but comparing it to the other defoliating Lepidoptera species presented in the researched crops, the presence of the *M. brassicae* was insignificant. The procentage of the parasitism in this year reached 100% to a density of 4 larvae/plant in the station: Sere Galaţi – 13. 07. 2000 (Fig.3). In 2001, it was remarked a nearly insignificant intervention of the parasitoid assemblages on the *Mamestra brassicae* L. population, when the maximum larval density on plant per station reached the number of 2,8 (Fig. 3).

At the pupae stage of the *M. brassicae* colected from the soil, it was recorded a percentage of parasitism of 90,4% due to Muscidae species (Diptera). *Euplectrus cacoeciae* (Ferrière, 1941) (Chalcidoidea) played a major rol at the larvae stage with an average of 59 % (Table 2, Fig. 2).

Regarding the dominance of the synecological analyses, the distribution of the four parasitoid species of the *M. brassicae* larvae and pupae indicates that the Muscidae species and *Euplectrus cacoeciae* are eudominat, the two being considered recedent species (Table 3). The constancy of the parasitoid species in the studied stations is included in small value clases, *Euplectrus cacoeciae* is just an accessorie species.

The index of ecological significance shows the species *Euplectrus cacoeciae* and Muscidae species as characteristic to parasitoid assemblage to the *Mamestra brassicae* defoliator. The two: *Macrocentrus collaris* (Spinola 1808) (Braconidae) and *Netelia silantjewi* (Kokujev, 1899) (Ichneumonidae) being considered accidental.

The presence of the hyperparasitoids was identified only in 2001 when the primary parasitoid *Euplectrus cacoeciae* was parasitized by *Baryscapus galactopus* (Ratzeburg, 1844) (Chalcidoidea) (Fig. 2).

Of the other studied Noctuidae species, *Autographa gamma* is an accessorie and *Helicoverpa armigera* is accidental in the cabbage crops and they don't represent a real damaging factor for the economy (Patriche, 2005).

The populations of the *Autographa gamma* larva land pupae were limited by the four species of primary parasitoids of which *Voria ruralis* (Fallen, 1810) (Diptera) played a dominant contribution of 50%, being followed by *Copidosoma truncatellum* (Dalman, 1820) (Chalcidoidea) (25%)*, Rhogas rossicus* (Kokoujev, 1898) (Braconidae) - 17%. An minor rol was registred by *Diadegma brevivalvis* (Thomson, 1887) (Table 2, Fig. 2).

Taking into account the dominance, *Voria ruralis*, *Copidosoma truncatellum* and *Rogas rossicus* are eudominant species and *Diadegma* *brevivalvis* is dominant. Considering the constancy, all four species are accidental, being identified in the maximim of 16,7% of the collecting data (Table3).

The index of ecological significance points aut the parasitoid *Voria ruralis* as characteristic species to the studied assemblage, the other species being accessories (Table3).

It was identified only one parasitoid species: *Hyposoter didimator* (Thunberg, 1822) (Ichneumonidae) for the *Helicoverpa armigera*, accidental defoliator found in the cabbage crops of the South-East of Romania (Table2, Fig. 2).

Conclusions

Among the defoliators Noctuidae species, which affected the cabbage crops, *Mamestra brassicae* was representative, the other two (*Autographa gamma* and *Helicoverpa armigera*) were less damaging. Excepting *T. evanescens* which acted at the eggs stages of the Noctuidae populations - for *M. Brassicae*, 4 primary parasitoid species and one of the secondary parasitoid were identified – for *A. gamma,* 4 primary parasitoid and for *H. armigera*, only one species of the primary parasitoid was identified.

Trichogramma evanescens*, parasitized the* Mamestra brassicae *and* Autographa gamma *eggs and it was the most effective in natural control of the researched defoliators. At the larval stage, the Muscidae for* Mamestra brassicae *and* Voria ruralis *for* Autographa gamma,*scored the high percentage. During the studied period for* Helicoverpa armigera *was identified only one primary parasitoid species -* Hyposoter didimator*, in the area of research.*

Rezumat

În această lucrare sunt prezentate rezultatele studiului privind complexele de parazitoizi primari şi secundari care intervin în controlul natural a trei specii de Noctuidae (*Mamestra brassicae* L., *Autographa gamma* L. şi *Helicoverpa armigera* Hbn.), defoliatoare în culturile de varză din sud-estul României. Pe parcursul perioadei 1998-2001 au fost identificate 5 specii de parazitoizi primari şi o specie de parazitoid secundar pentru *Mamestra brassicae*, 4 specii de parazitoizi primari care au acționat în populațiile de *Autographa gamma* şi un parazitoid primar aferent speciei *Helicoverpa armigera*. Limitarea cea mai eficientă a noctuidului *M. brassicae*, specie caracteristică culturilor de varză din regiunea studiată, a fost realizată la nivelul ouălor, de către *Trichogramma evanescens* Westwood, 1833. La nivelul larvelor un rol major l-a înregistrat specia *Euplectrus cacoeciae* Ferrière., care constituie o relație gazdă - parazitoid nouă pentru ştiință iar *Macrocentrus collaris*, obținută ca parazitoid primar tot din *M. brassicae*, reprezintă o relație gazdă - parazitoid nouă pentru România.

Este analizată relația dintre densitatea larvelor de Noctuidae şi rata parazitării precum şi abundența, dominanța şi constanța speciilor de parazitoizi primari.

References

1. ANDRIESCU I., MOGLAN V., MOGLAN I., GROZEA G., 1992 – *Eficiența spontană a Trihogramei (Hym. Trychogrammatidae) în culturile de varză cu diferite grade de protecție fitosanitară din România*. Protecția Plantelor, Tipo Agronomia Cluj-Napoca, II:6, pp. 77-78.
2. ATANASOV A Z., YONAITIS V.P., KASPARIAN A.R., KUSLIŞKII V.S., RASNIȚÂN A.P., SIYTAN U.V., TOLKANIȚ V.I., 1981 - *Opredeliteli nasekomâh evropeiskoi ceasti* SSSR, Tom III, Pereponceatokrâlâie, Tretia ceasti, Nauka, Leningrad, pp.688.
3. AUBERT F. F., 1978 – *Les Ichneumonides Quest-Paleardtiques et leurs hôtes, 2, Brachinae*, E.D.I.F.A.T. – O.P.I.D.A., Echauffour, France pp. 318.
4. CONSTANTINEANU M. I., 1959 - *Familia Ichneumonidae, subfam. Ichneumoninae, tribul Ichneumoninae Stenopneusticae*. Fauna R.S.R, IX, 4, Ed. Acad. R.S.R.. Buc., pp. 1248.
5. COSTEA G., MUSTAȚĂ GH., LOZAN A., 2002 - *Role of Braconidae (Hymenoptera) in limitation of lepidoptera cabbage pests populations in Romania*. *In* Parasitic Wasps: Evolution, Systematics, Biodiversity and Biological Control. Agroinform, Budapest, pp 391-395
6. IONESCU M., 1961 - *Cercetări biologice şi de combatere a larvelor de buha verzei - Mamestra brassicae L. (Ord. Lepidoptera, Fam. Noctuidae*). Stud. cercet. bioI. Seria Zool., 17, 2;
7. IONESCU C., PAŞOL P., 1987 - *Structura, răspândirea şi dinamica sezonieră a principalelor specii de Noctuide dăunătoare plantelor de cultură din România în anul 1984* - Lucrări ştiințifice 1. A. N.B. Buc, XXX ser. A, pp. 49 -57;
8. MANOLACHE C., SĂVESCU A., BOGULEANU GH., PAULIAN FI., BĂLAJ D., PAŞOL P., 1969 - *Entomologia agricolă*, Buc., Ed. Agrosilvică;
9. MUSTAȚĂ GH., 1973 - *Biologia şi ecologia insectelor parazite în insectele dăunătoare legumelor din Moldova -*

Teză de doctorat, Iaşi, Univ. " AI.I. Cuza"; pp. 421.
10. PATRICHE G., 2005 - *The attack situations of lepidoptera species on the cabbage crops in South-Eastern Romania. Oltenia*. Studii şi comunicări. Ştiinţele Naturii, XXI, pp. 81-86;
11. PATRICHE G., 2005 - *Intervenţia parazitoizilor primari în controlul populaţiilor de Lepidoptere defoliatoare în culturile de varză din sud-estul României*. Acta Universitas Cibiniensis, Seria Ştiinţe Agricole, Vol.1, nr. 1(5), pp. 257-26
12. PISICĂ C., 2001 - *Ichneumonidele (Hymenoptera, Insecta) din România şi gazdele lor*. Catalog, Ed. Univ. „Al. I. Cuza", Iaşi, pp.406.
13. PERJU T., LĂCĂTUŞU M., PISICĂ C., ANDRIESCU I., MUSTAŢĂ GH., 1989 - *Entomofagii şi utilizarea lor în protecţia integrală a ecosistemelor horticole*, Buc., Ed. Ceres, pp.288.
14. SHOW M. R., 1994 – *Parasitoid host ranges în Parasitoid Community Ecology*, Oxford University Press, Oxford, pp. 111-144
15. TALIŢKII V.I., KUSLIŢKII V. S., 1990 - *Parazâticeskie, pereponciatokrâlâe Moldavia* (Katalog) VNIIBMYR, Kişinev, Cartea Moldovenească, pp. 304.
16. TOBIAS V.I., 1995 – *Keys to the fauna of the USSR*, Institute of Zoology, Academy of Sciences of the USSR, No. 145, Volum III, Hymenoptera, part IV, Oxonian Press, New Delhi, pp. 883.
17. VELICANI V. S. et al., 1982 - *Opredeliteli ovoşcinâh kulitur i kartofelea v SSSR*, Kolos, Leningrad, pp.272.

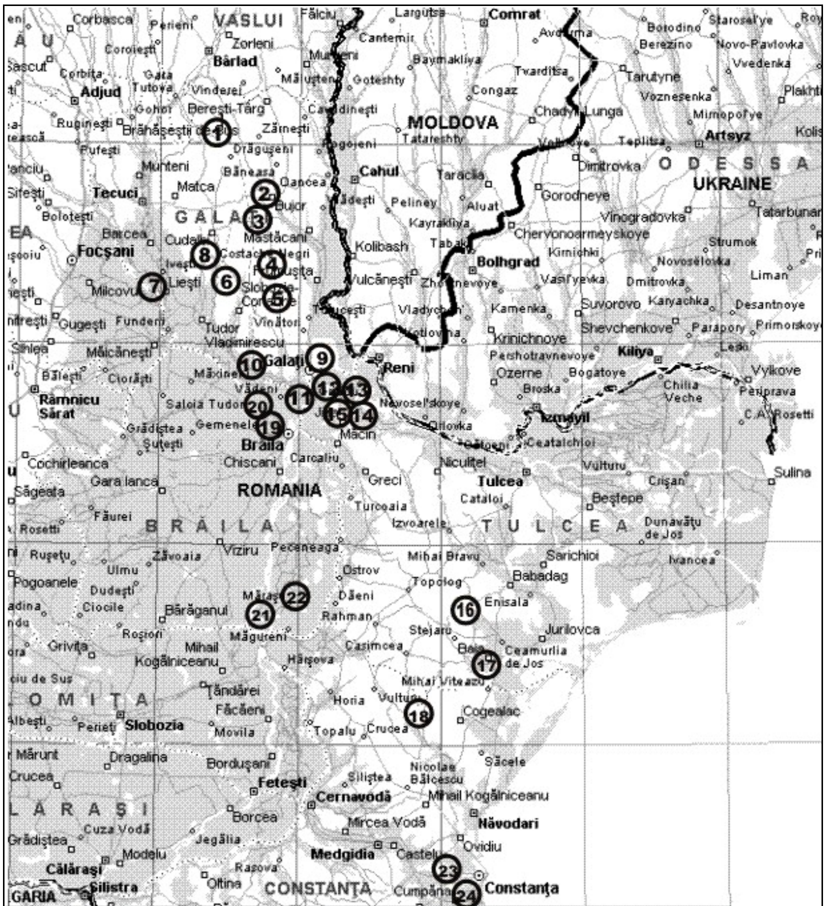

Figure 1 South - Eastern Romania with sampling sites
Galaţi county: 1 - Găneşti, 2 - Tg. Bujor, 3 - Umbrăreşti, 4 - Costachi Negri, 5- Slobozia Conachi, 6 - Suhurlui, 7- Lieşti, 8 - Vameş, 9 - Sere Galaţi, 10 - Şendreni
Tulcea county: 11 - Smârdan, 12 - Cetatea Dinogeţia, 13 - Garvăn, 14 - Văcăreni, 15 - Luncaviţa, 16 - Gaugagia, 17 - Baia, 18 - Alba
Brăila county: 19 - Ieşire Brăila, 20 - Baldovineşti, 21 - Insula Mica a Brăilei, 22 - Mărașu
Constanţa county: 23 - Poiana, 24 - Agigea

Tab. 1 - The importance of the egg parasite, *Trichogramma evanescens*, in reducing the Noctuidae populations

Locality	Collection data	*Mamestra brassicae L.*				*Autographa gamma L.*			
		Number of clutches	Total number of the eggs	Parasitized eggs		Number of clutches	Total number of the eggs	Parasitized eggs	
				Nr.	%			Nr.	%
Tg. Bujor	12.07.1998	64	2972	1865	62,7	2	79	40	50,6
Grivița	15.07.1998	10	303	198	65,3	1	22	7	31,8
Movileni	15.07.1998	12	419	220	52,5	2	37	6	16,2
I. Mică a Brăilei	29.07.1998	6	382	272	71,2	-	-	-	-
Mărașu	31.07.1998	17	1185	789	66,5	-	-	-	-
Total		109	5261	3344	63,5	5	138	53	38,4

Tab. 2 - The percents of primary parasitoid species which limit the Noctuidae populations

Noctuidae species	Year	% Parasitized	% larvae and pupae parasitized by *M. brassicae*				% larvae and pupae parasitized by *A. gamma*				% larvae and pupae parasitized by *H. armigera*
			Macrocentrus collaris	*Netelia silantjewi*	*Euplectrus cacoeciae*	*Muscidae - Diptera*	*Rogas rossicus*	*Diadegma brevivalvis*	*Copidosoma truncatellum*	*Voria ruralis*	*Hyposoter didimator*
Mamestra brassicae	1998	51.5	-	-	7,8	92,2					
	1999	27.5	-	3	81,8	15,2					
	2000	25.3	5,6	-	44,4	50					
	2001	1.5	-	-	100	-					
	1998-2001	**29.1**	**1**	**1**	**39**	**59**					
Autographa gamma	1998						-	-	-	-	
	1999	35.8					-	-	40	60	
	2000	7.7					-	-	-	100	
	2001	30					33,3	16,7	16,7	33,3	
	1998-2001	**21**					**16,7**	**8,3**	**25**	**50**	
Helicoverpa armigera	1998										**-**
	1999										**-**
	2000	27.3									100
	2001										-
	1998-2001	**15**									**100**

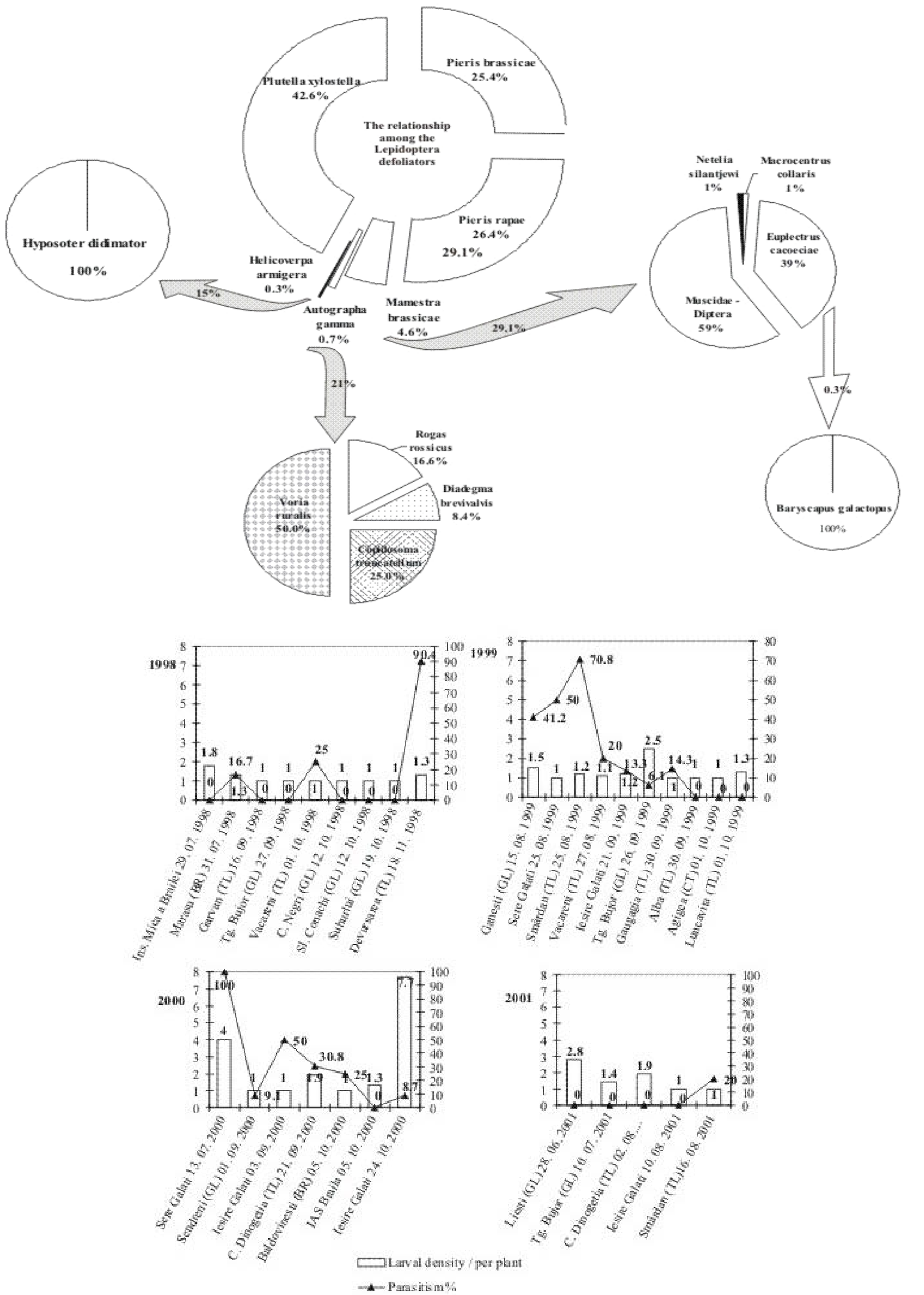

Fig. 3 - Incidence of *Mamestra brassicae* larval populations and parasitism per sampling dates, by its parasitoids (1998 - 2001)

Tab. 3 - The synecological analysis of the parasitoid species in the Pieridae pest populations
(A) =Abundance; (D) =Dominance; (C) = Constancy; (IES) = Index of ecological significance

Mamestra brassicae					***Autographa gamma***				
Species	**(A) No**	**(D) %**	**(C) %**	**(IES) %**	**Species**	**(A) No**	**(D) %**	**(C) %**	**(IES) %**
Muscidae - Diptera	61	59.2	12.9	7.6	*Voria ruralis*	6	50	16.7	8.4
Euplectrus cacoeciae	40	38.8	41.9	16.3	*Copidosoma truncatellum*	3	25	16.7	4.2
Macrocentrus collaris	1	1	3.2	0.03	*Rogas rossicus*	2	16.7	5.6	0.9
Netelia silantjewi	1	1	3.2	0.03	*Diadegma brevivalvis*	1	8.3	5.6	0.5

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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WINTER RESEARCH ON THE POULTRY OF THE CVERCINEE BRUSH TREATED AGAINST DEFOLIATORS

CĂTĂLIN RANG, CONSTANTIN CIORNEI, CONSTANTIN NEŢOIU,
COSTEL BURGHELEA, ROXANA VOICU,
DUMITRA RĂDUCANU, DANIELA VRÂNCEANU

ABSTRACT

RANG C., CIORNEI C-TIN, NEŢOIU C-TIN, BURGHELEA C., VOICU R., RĂDUCANU D., VRÂNCEANU D., Winter research on the poultry of the cvercinee brush treated against defoliators, *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 502-511.

Researches on the Cvercinee brush treated against defoliators have been made for many years between 1980 – 2003.
The analysed biological material was obtained after a long proces of gathering of the birds during winter time in the Cvercinee forests in which the evolution regarding their diversity was also made.

Key words: forest, birds, food, winter.

Researching place

Regarding the evaluation on the wintering avifauna within the cvercinee arboretum subjected to this study, the following forests have been examined:

- Poeni and Şanta forest (Iasi)
- Dumbrava forest
- Heltiu, Paltinata and Cornatel forest (Bacau)
- Comana and Daita forest (Giurgiu).

Periods and study methods

The poultry evaluation were preformed during the winter season (November/ March) between 2005 - 2007, in some forests with cvercinee within their structure, where, in the previous years different activities of prevention and control against defoliators had been carried out.

For the avifauna's inventory, living during the hibernal aspect within the cvercinee brush selected for the present study, observations were made especially along some routes used by the brush (arboretum) in different directions, without taking into account the roads and the access paths.

The routes were covered in ¾ hours for an evaluation.

After 25/30 minutes of walking along a route, 10- 15 minutes breaks were made in order to listen and to identify some mixed erratic flocks.

In order to create an image concerning the winter food regime of the poultry species belonging to the studied brush the necessary material was gathered, and the bird's stomachal content was analysed in the laboratory.

Discussion on the study's results

• 34 species of hibernating birds were identified in the 8 forests in which the evaluations were made (table nr. 1).

The smalesr number, of 15 species, was found in the Comana forest and the largest number of species (19) was found in the Poemi, Dumbrava, Heltiu, Daita.

Compared to the total number of observing species, the existent differences are not very important, being determinate by moment of the mixed flock, intersection looking for food.

During the winter time the birds living in the forests do not keep their territories as they used to during the nesting period and are in a permanent movement searching for food. Their form mixed flocks up to 10 species having between 50 and 100 individuals.

24 species (meaning 70% of the whole group, ones studied belong to the category of **sedentary** (non-emigrant) birds.

Five species (15 % of total number of studied birds: *Erithacus rubecula, Fringilla coelebs, Sturnus vulgaris, Turdus merula and Turdus viscivorus,* are considered **summer guests**, but whenever exists at least a few sources of nourishment during the winter period, some birds usually prefer to give up migration and stay here.

This year's lack of snow favoured this phenomenon. The **winter guests** (5 species, meaning 15% of the bird's population studied) *Butteo lagopus, Carduelis spinus, Lanius excubitor, Regulus regulus and Turdus pilaris,* were accidentally discovered as being an element of the studied brush, because in the winter these do not offer abundant and accessible food resources.

Tabelul nr. 1 – Species of birds present during winter time in cvercinee arboretum.

Nr. crt.	SPECIES	Type of fauna	Fenology	FOREST							
				Şanta	Poieni	Dumbrava	Heltiu	Păltinata	Cornățel	Comana	Dăița
0	1	2	3	4	5	6	7	8	9	10	11
1	*Accipiter gentilis (L.)*	Tp	Sd	x			x	x			
2	*Accipiter nisus (L.)*	Tp	Sd	x	x	x					x
3	*Aegithalos caudatus (L.)*	Tp	Sd			x	x	x			
4	*Buteo buteo (L.)*	Tp	OI		x				x	x	x
5	*Buteo lagopus (Pontop.)*	A	OI			x			x		
6	*Carduelis spinus (L.)*	E	OI			x	x	x	x		
7	*Cethia familiaris L.*	E	Sd	x		x		x	x	x	
8	*Coccothraustes coccothraustes (L.)*	E	OI	x	x	x	x	x	x	x	x
9	*Corvus corax L.*	Tp	Sd				x	x	x		
10	*Corvus frugilegus L.*	E	OI	x							x
11	*Dendrocopos major (L.)*	Tp	Sd	x	x	x	x	x	x	x	x
12	*Dendrocopos medius (L.)*	E	Sd		x	x	x	x		x	
13	*Dendrocopos minor (L.)*	Tp	S								x
14	*Emberiza citrinella L.*	S	OI	x	x		x			x	x
15	*Erithacus rubecula (L.)*	E	OV							x	x
16	*Fringilla coelebs L.*	E	OV							x	
17	*Garrulus glandarius (L.)*	E	Sd	x	x	x	x	x	x	x	x
18	*Lanius excubitor L.*	Tp	OI	x	x				x		x
19	*Parus ater L.*	E	Sd					x			
20	*Parus caeruleus L.*	E	Sd	x	x	x	x	x	x	x	x
21	*Parus major L.*	E	Sd	x	x	x	x	x	x	x	x
22	*Parus palustris L.*	S	Sd	x	x		x	x			
23	*Passer domesticus (L.)*	Tp	Sd		x	x					x
24	*Passer montanus (L.)*	Tp	Sd		x	x					
25	*Pica pica (L.)*	E	Sd	x	x		x		x		x
26	*Picus canus Gmel.*	E	Sd	x	x	x	x		x		
27	*Picus viridis L.*	E	Sd							x	
28	*Regulus regulus (L.)*	E	OI				x	x	x		x
29	*Sitta europaea L.*	Tp	Sd	x	x	x	x	x	x	x	x
30	*Sturnus vulgaris L.*	E	OV							x	x
31	*Troglodytes troglodytes (L.)*	E	Sd	x	x	x	x				x
32	*Turdus merula L.*	E	OV			x	x			x	x
33	*Turdus pilaris L.*	S	OI	x	x	x	x		x		
34	*Turdus viscivorus L.*	E	OI		x	x		x	x		

LEGEND:
Type of fauna: Tp - transpalearctic; E - european; S - siberian.
Fenology: Sd - sedentary; OV – summer guests; OI – winter guests.

According to the fauna typology 20 species (50% of the bird population studied) belong to the **european** type, which together with the **transpaleartic** category (11 species meaning 32% bird population studied) actually represent the overwhelming majority of species specific to the Romanian avifauna.

• 82 samples belonging to 15 species of birds have been collected from this particular environment. Their stomachal contents have been analysed and the following results were obtained:

1. *Picus canus*

a) 1 recoltated sample: 11.01.2007 – Şanta forest (Iaşi)
- *Ord. Hymenoptera* - *fam. Formicidae* = 650 ex.
- *Ord. Coleoptera* (larvae) = 230 ex.

b) 1 recoltated sample: 18.02.2006 – Heltiu forest (Bacău)
- *Ord. Hymenoptera* - *fam. Formicidae* = 150 ex.

2. *Dendrocopos major*

a) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- *Ord. Araneida* (ad.) = 7 ex.
- *Ord. Coleoptera* - *fam. Elateridae* (*gen. Agriotes)* = 3 ex.
  - *fam. Chrysomelidae* = 1 ex.
  - *fam. Scarabeidae* = 2 ex.
  - larvae = 1 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 100 ex.
- Fragments of insects (0,2 - 2 mm) = 250
- Vegetal materials (0,4 - 3 mm) = 200
- Seeds (1 – 2 mm) = 130

b) 3 recoltates samples: 18.02.2006 – Heltiu forest (Bacău)
- *Ord. Acarina* = 1 ex.
- *Ord. Araneida* = 1 ex.
- *Ord. Coleoptera* - *fam. Staphylinidae* = 5 ex.
  - fragments (0,3 – 3 mm) = 100
  - larvae = 2 ex.
- *Ord. Diptera* - larvae = 1 ex.
- *Ord. Hymenoptera* - *fam. Braconidae* = 2 ex.
- *Ord. Homoptera (Coccide)* - larvae = 2 ex.
- *Ord. Plecoptera* = 1 ex.
- Insect eggs = 7
- Seeds (fragments 0,3 – 3 mm) = 1.000

c) 2 recoltates samples: 22.01.2007 – Dăița forest (Giurgiu)
- *Ord. Coleoptera* - *fam. Curculionidae* (*gen. Liparus)* = 6 ex.
  - *fam. Staphylinidae* = 50 ex.
  - *fam. Elateridae* = 2 ex.
  - *fam. Carabidae* = 2 ex.
- *Ord. Diptera* - larvae = 20 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 3 ex.
  - *fam. Braconidae* = 5 ex.
- *Ord. Homoptera (Coccide)* = 1 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 2 ex.
- Fragments of insects (1 - 4 mm) = 1000
- Vegetal materials (1,5 - 3 mm) = 15
- Seeds (2 – 3 mm) = 20

d) 2 recoltates samples: 14.02.2007 – Heltiu forest (Bacău)
- *Ord. Araneida* = 2 ex.
- *Ord. Coleoptera* - *fam. Carabidae* (*gen. Harpalus)* = 2 ex.
  - fragments (0,2 – 1 mm) = 100 ex.
- *Ord. Diptera* - larvae = 6 ex.

- *Ord. Hymenoptera* - larvae = 12 ex.
- Fragments lemnoase (0,2 - 2 mm) = 60
- Seeds (fragments 0,5 – 3 mm) = 120

3. *Dendrocopos medius*

a) 4 recoltates samples: 06-07.02.2006 – Heltiu forest (Bacău)
- *Ord. Pseudoscorpiones* = 3 ex.
- *Ord. Araneida* = 2 ex.
- *Ord. Coleoptera* - fragments (0,3 – 2 mm) = 150 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 21 ex.
- *Ord. Homoptera (Coccide)* larvae = 1 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 2 ex.
- Insect eggs = 6
- Fragments vegetale (0,4 - 3 mm) = 2500
- Gastrolytes (0,4 – 3 mm) = 220

b) 1 recoltated sample: 08.02.2006 – Heltiu forest (Bacău)
- *Ord. Araneida* = 2 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 15 ex.
- *Ord. Homoptera (Coccide)* larvae = 25 ex.
- Fragments of insects (0,1 – 2 mm) = 500
- Fragments vegetale (0,2 - 4 mm) = 70

c) 2 recoltates samples: 11.01.2007 – Şanta forest (Iaşi)
- *Ord. Acarina* = 1 ex.
- *Ord. Araneida* = 1 ex.
- *Ord. Coleoptera* - fragments (0,1 – 3 mm) = 800 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 56 ex.
- *Ord. Homoptera* - *fam. Cicadelidae* = 4 ex.
  - *s.o. Coccide* (larvae) = 11 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 3 ex.
- Fragments vegetale (0,1 – 0,5 mm) = 150
- Seeds (1 – 1 mm) = 37

d) 1 recoltated sample: 14.02.2007 – Heltiu forest (Bacău)
- *Ord. Pseudoscorpiones* = 1 ex.
- *Ord. Coleoptera* - *fam. Curculionidae* (*gen. Curculio)* = 3 ex.
- *Ord. Lepidoptera* - larvae = 8 ex.
- *Ord. Homoptera* - *(Coccide)* = 2 ex.
- Fragments of insects (0,5 – 2 mm) = 40
- Seeds (0,5 - 2 mm) = 130
- Gastrolytes (1 – 2 mm) = 3

4. *Dendrocopos minor*

a) 1 recoltated sample: 22.01.2007 – Dăița forest (Giurgiu)
- *Ord. Lepidoptera* (larvae) = 4 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 35 ex.
- Fragments of insects (0,5 – 4 mm) = 70

5. *Garrulus glandarius*

a) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- Fragments of insects (0,2 – 3 mm) = 30 *(Coleoptera?)*
- Mammal hair
- Seeds (4 - 5 mm) = 10
- Gastrolytes (2 – 4 mm) = 40

6. *Regulus regulus*

a) 2 recoltates samples: 22.01.2007 – Dăița forest (Giurgiu)

- *Ord. Coleoptera* - *fam. Bupestridae* = 3 ex.
  - *fam. Scarabeidae* = 1 ex.
- *Ord. Diptera* = 1 ex.
- *Ord. Homoptera* - *fam. Cercopidae* = 3 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 6 ex.
- Insecte - fragments (0,2 – 2 mm) = 1500
  - pupes = 8 ex.

7. ***Turdus pilaris***

a) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- *Ord. Coleoptera* - *fam. Curculionidae (Curculio)* = 2 ex.
- Fragments vegetale (0,3 – 4 mm) = 30
- Seeds (2 – 4 mm) = 3

8. ***Parus palustris***

a) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- Fragments vegetale (1 – 2 mm) = 15
- Seeds (1 – 2 mm) = 8
- Gastrolytes (2 mm) = 20

b) 2 recoltates samples: 09.02.2006 – Dumbrava forest (Neamț)
- *Ord. Diptera* (larvae) = 1 ex.
- Fragments of insects 0,2 – 0,4 mm) = 15
- Fragments vegetale (1 - 2 mm) = 50
- Gastrolytes (2 mm) = 60

c) 3 recoltates samples: 18.02.2006 – Heltiu forest (Bacău)
- *Ord. Coleoptera* - *fam. Curculionidae (Cionus)* = 27 ex.
  - *fam. Elateridae (Agriotes)* = 3 ex.
  - fragments (0,3 – 3 mm) = 1200
- Insect eggs = 8 ex.
- Fragments vegetale (0,2 - 2 mm) = 100
- Seeds (2 mm) = 3
- Gastrolytes (0,5 - 3 mm) = 120

9. ***Parus caeruleus***

a) 2 recoltates samples: 06-07.02.2006 – Heltiu forest (Bacău)
- *Ord. Coleoptera* - *fam. Scarabidae* (larvae) = 1 ex.
- *Ord. Lepidoptera* (larvae) = 1 ex.
- *Ord. Homoptera (Coccide)* larvae = 3 ex.; adulți = 4 ex.
- *Ord. Heteroptera* = 1 ex.
- Insecte - fragments (0,3 – 2 mm) = 100
  - pupes = 3 ex.
  - eggs = 3 ex.
- Fragments vegetale (0,2 - 2 mm) = 25

b) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- *Ord. Coleoptera* - *fam. Staphylinidae* = 2 ex.
- *Ord. Diptera* (larvae) = 20 ex.
- *Ord. Homoptera (Coccide)* - larvae = 2 ex.
- Fragments of insects (0,1 – 2 mm) = 300
- Fragments vegetale (1 - 2 mm) = 20

c) 1 recoltated sample: 09.02.2006 – Dumbrava forest (Neamț)
- *Ord. Coleoptera* = 1 ex.
- *Ord. Lepidoptera* (larvae) = 1 ex.
- *Ord. Diptera* (larvae) = 1 ex.
- Fragments of insects (0,1 – 3 mm) = 100
- Seeds (1,5 - 2 mm) = 50

d) 3 recoltates samples: 22.01.2007 – Dăița forest (Giurgiu)
- *Ord. Coleoptera* - *fam. Curculionidae (Curculio)* = 2 ex.
- *fam. Chrysomelidae* = 6 ex.
- *fam. Scarabidae* = 1 ex.
- fragments (1 – 3 mm) = 700
- *Ord. Diptera* (larvae) = 32 ex.
- *Ord. Homoptera (Coccide)* = 1 ex.
- *Ord. Heteroptera* = 1 ex.
- Insecte - eggs = 40 ex.
- pupes = 3 ex.
- larvae = 1 ex.

10. *Parus ater*
a) 1 recoltated sample: 14.02.2007 – Heltiu forest (Bacău)
- *Ord. Araneida* = 2 ex.
- *Ord. Diptera* (larvae) = 32 ex.
- Insecte - fragments (0,3 – 1 mm) = 20
- eggs = 18
- Fragments vegetale (0,3 - 3 mm) = 200
- Gastrolytes (1 - 2 mm) = 60

11. *Parus major*
a) 12 recoltates samples: 06-07.02.2006 – Heltiu forest (Bacău)
- *Ord. Araneida* = 1 ex.
- *Ord. Coleoptera* - *fam. Curculionidae (Liparus)* = 3 ex.
- *fam. Buprestridae* = 1 ex.
- *Ord. Lepidoptera* (larvae) = 1 ex.
- *Ord. Diptera* (larvae) = 3 ex.
- Insecte - fragments (0,2 – 2 mm) = 1000
- pupes = 4
- eggs = 35
- Fragments vegetale (0,5 - 2 mm) = 60

b) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- Insecte fragments (0,1 – 2 mm) = 150 *(Coleoptera, Hymenoptera, Heteroptera)*
- Fragments vegetale (2 - 4 mm) = 50
- Seeds (2 - 4 mm) = 2
- Gastrolytes (4 - 5 mm) = 30

c) 2 recoltates samples: 18.02.2006 – Heltiu forest (Bacău)
- *Ord. Pseudoscorpiones* = 2 ex.
- *Ord. Araneida* = 2 ex.
- *Ord. Coleoptera* (larvae) = 1 ex.
- *Ord. Hymenoptera* - *fam. Formicidae* = 4 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 1 ex.
- Insecte - fragments (0,1 – 4 mm) = 600
- eggs = 25

d) 2 recoltates samples: 11.01.2007 – Poieni forest (Iaşi)
- *Ord. Coleoptera* - *fam. Curculionidae (Curculio)* = 2 ex.
- larvae = 1 ex.
- fragments (1-3 mm) = 500 *(Scarabeidae, Carabidae)*
- Fragments vegetale (0,2 - 2 mm) = 900

e) 4 recoltates samples: 22.01.2007 – Dăița forest (Giurgiu)
- *Ord. Pseudoscorpiones* = 12 ex.
- *Ord. Araneida* = 3 ex.
- *Ord. Coleoptera* - *fam. Curculionidae* = 19 ex.
- *fam. Elateridae* = 9 ex.

- *fam. Chrysomelidae (Galeruca)* = 1500 fragments
- *fam. Scarabidae* = 2 ex.
- *fam. Carabidae* = 1 ex.

- *Ord. Lepidoptera* - larvae = 2 ex.
  - pupes = 2 ex.
- *Ord. Diptera* - larvae = 29 ex.
- *Ord. Hymenoptera* - *fam. Cynipidae* = 1 ex.
- *Ord. Homoptera* - *(Coccide)* = 1 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 15 ex.

f) 8 recoltates samples: 14.02.2007 – Heltiu forest (Bacău)
- *Ord. Pseudoscorpiones* = 3 ex.
- *Ord. Coleoptera* - fragments (0,3 – 2 mm) = 1200
- *Ord. Lepidoptera* (larvae) = 4 ex.
- *Ord. Diptera* (larvae) = 3 ex.
- *Ord. Homoptera* - *(Coccide)* = 14 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 1 ex.
- Insecte - eggs = 53
- Fragments vegetale (0,2 - 2 mm) = 600
- Seeds (1 - 2 mm) = 79
- Gastrolytes (2 mm) = 2

12. ***Sitta europaea***

a) 4 recoltates samples: 06-07.02.2006 – Heltiu forest (Bacău)
- *Ord. Coleoptera* - *fam. Curculionidae (Curculio)* = 1 ex.
  - fragments (0,3-2 mm) = 50 *(Scarabeidae, Carabidae)*
- *Ord. Hymenoptera* - *fam. Formicidae* = 2 ex.
- *Ord. Homoptera* - *(Coccide)* = 6 ex.
- *Ord. Heteroptera* - *fam. Reduviidae* = 1 ex.
  - *fam. Nabidae* = 1 ex.
- Insecte (fragments 0,1 – 2 mm) = 200
- Fragments vegetale (0,5 - 2 mm) = 50
- Seeds (1,5 - 2 mm) = 10
- Gastrolytes (0,5 - 3 mm) = 68

b) 1 recoltated sample: 08.02.2006 – Poieni forest (Iaşi)
- *Ord. Coleoptera* - fragments (0,1 - 1 mm) = 150
- *Ord. Homoptera* - *(Coccide)* larvae = 2 ex.
- Fragments vegetale (1 - 2 mm) = 100
- Seeds (0,2 - 4 mm) = 20
- Gastrolytes (0,3 - 3 mm) = 250

c) 4 recoltates samples: 18.02.2007 – Heltiu forest (Bacău)
- *Ord. Pseudoscorpiones* = 2 ex.
- *Ord. Coleoptera* - *fam. Staphylinidae* = 1 ex.
- *Ord. Diptera* (larvae) = 12 ex.
- *Ord. Hymenoptera* = 2 ex.
- *Ord. Heteroptera* - *fam. Nabidae* = 3 ex.
  - unidentified = 1 ex.
- Insecte (fragments 0,1 – 2 mm) = 1000
- Fragments vegetale (0,1 - 4 mm) = 100
- Seeds (1 - 3 mm) = 15
- Gastrolytes (0,2 – 3 mm) = 200

d) 3 recoltates samples: 11.01.2007 – Şanta forest (Iaşi)
- *Ord. Coleoptera* - fragments (0,3 - 2 mm) = 250
- *Ord. Hymenoptera* = 1 ex.
- *Ord. Homoptera* - *(Coccide)* larvae = 6 ex.
- Insecte - fragments (0,3 – 2 mm) = 400

- eggs = 2
- Fragments vegetale (1 - 2 mm) = 25
- Seeds (2 - 3 mm) = 60
- Gastrolytes (2 mm) = 75

e) 1 recoltated sample: 11.01.2007 – Poieni forest (Iaşi)
- *Ord. Coleoptera* - fragments (0,2 – 0,5 mm) = 150
  - larvae = 1 ex.
- *Ord. Diptera* (larvae) = 3 ex.
- *Ord. Hymenoptera* - *fam. Cyprinidae* = 1 ex.
- *Ord. Homoptera* - *(Coccide)* larvae = 2 ex.
- Fragments vegetale (0,1 - 3 mm) = 250
- Gastrolytes (0,5 - 2 mm) = 70

13. *Pyrrhula pyrrhula*

a) 1 recoltated sample: 09.02.2006 – Dumbrava forest (Neamț)
- Insecte - fragments (1 – 3 mm) = 250
- Seeds (3 - 5 mm) = 100
- Gastrolytes (1 - 3 mm) = 100

14. *Coccothraustes coccothraustes*

a) 1 recoltated sample: 09.02.2006 – Dumbrava forest (Neamț)
- Fragments vegetale (2 - 3 mm) = 50
- Seeds (2 - 5 mm) = 70

15. *Emberiza citrinella*

a) 1 recoltated sample: 18.02.2006 – Dumbrava forest (Neamț)
- Seeds (1 - 3 mm) = 40
- Gastrolytes (1 - 3 mm) = 15

The technical literature. Concerning nestling the studied issue almost exclusively refers to the feeding of the birds that build nests in the forest.

The structure of their digestive system offer (almost without being necessary to analyse significant details) information about the use of insect's, larvae in their nourishment as well as of some other invertebrates having a soft body.

As for the chickens hatching moments, it can be easily noticed that the studied period is from April to June.

The food of the adult birds is incompletely studied as for the winter nourishment, it is even less known.

Inside the 82 bird's stomachs, belonging to 15 species of birds gathered during the winter in the Cvercinee brush, fragments belonging to two invertebrate classes were indentified.

The small tegument fragments (0,1-3 mm) allowed the identification of their belonging to 10 subclasses or categories (*Araneae, Acarina, Pseudoscorpiones, Plecoptera, Coleoptera, Lepidoptera, Diptera, Hymenoptera, Homoptera, Heteroptera*, *Curculionidare, Buprestidae, Staphylinidae, Elateridae, Chrysomelidae, Scarabidae, Carabidae, Formicidae, Braconidae, Cynipoidea, Cercopidae, Cicadelidae, Coccide, Nabidae* and *Reduviidae*).

The interesting aspect is that, except from the *Lepidoptera and Diptera* (of which only larvae were found) the other groups have been determined due to some fragments of adult individuals. (table nr 2).

Tabel nr. 2 – The alimentary spectrum of some birds species in the Cvercinee forests during winter time.

Nr. crt.	FOOD CATEGORY				COMSUMER CATEGORY														
	CLASS	SUBCLASS CATEGORY	FAMILY	GENUS	*Coccothraustes cocc.*	*Dendrocopos major*	*Dendrocopos medius*	*Dendrocopos minor*	*Emberiza citrinella*	*Garrulus glandarius*	*Parus ater*	*Parus caeruleus*	*Parus major*	*Parus palustris*	*Picus canus*	*Pyrrhula pyrrhula*	*Regulus regulus*	*Sitta europaea*	*Turdus pilaris*
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Arahnida	Araneae				A	A				A		A						
2		Acarina				A	A												
3		Pseudoscorpiones					A						A					A	
4	Insecta	Plecoptera				A													
5		Coleoptera	Curculionidae	Liparus		A							A						
6				Curculio			A					A	A					A	A
7				Cionus										A					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8				Neidentif.								A	A						
9			Buprestidae										A				A		
10			Staphylinidae			A						A						A	
11			Elateridae	Agriotes		A							A	A					
12			Chrysomelidae	Galeruca		A						A	A						
13			Scarabeidae			AL						L	AL						
14			Carabidae	Harpalus		A							A						
15			Unidentified			AL	A					AL	AL	A	L			AL	
16		Lepidoptera					L	L				L	LP						
17		Diptera				L					L	L	L	L			L	L	
18		Hymenoptera	Formicidae			A	A	A					A		A			A	
19			Braconidae			A													
20			Cynipoidea										A					A	
21			Unidentified			A													
22		Homoptera	Cercopidae														A		
23			Cicadelidae				A												
24			Coccine			L	L					L	L					L	
25			Nabidae			A	A						A					A	
26		Heteroptera	Redreviidae														A	A	
27			Unidentified			O	OA	A		A			A						
28		Unidentified									OA		OP	OA			AP	AO	
29	Vegetale	Fragments			x	x	x				x	x	x	x		x		x	x
30		Seeds			x	x	x		x	x		x	x	x		x		x	x
31	Gastrolytes						x		x	x	x		x	x		x		x	

LEGEND:
A – indivizi adulți; P – Pupes; L – larvae; O – Eggs; x - prezența.

This fact may be considered as being a very important one because adult birds, during winter, have an extremely important impact on the biological reserve of some defoliators, which will breed the following year.

We can't however, neglect the fact, that the impact some invertebrates, that are, in the adult stage, takes place at random, this way important predators as: *Araneae, Staphylinidae, Carabidae, Formicidae, etc.*

On the other side, because of the last winter lack of snow, there appeared the possibility that many birds come down in order to look for food in the forest's soil, scratching the litter, the place where the most important adult invertebrate reserves can be found in this time of the year.

Even though some of the collected bird species *(Dendrocopos sp., Parus sp., Sitta europaea)* are classified as being insect eaters, inside their stomachs, were also found scraps of vegetal material matter as well as fragments of some plant seeds.

The presence of gastrolytes also indicates that the nourishment system of the birds is not completely that of a predator.

Rezumat

Au fost efectuate cercetări în arborete cu cvercinee care au fost tratate contra defoliatorilor pe parcursul mai multor ani în intervalul de timp 1980 – 2003.

Materialul biologic analizat a fost obținut în urma acțiunilor de recoltare a păsărilor pe perioada de iarnă din pădurile de cvercinee în care s-au făcut şi evaluările privind diversitatea specifică a acestora.

References

1. FERRY, C. - 1960 - *"Recherches sur l'ecologie des oiseaux fôrestiers en Bourgogne. L'avifaune nidificatrice d'un taillis sans futais de querceto-carpinetum."* - Alauda, 28, nr.2, Paris, pp. 93-103.
2. FERRY, C. - 1970 - *"L'avifaune nidificatrice d'une fôret de chenes pedoncules en Bourgogne: etude de deux succesions écologiques."* - La Terre et la Vie, nr. 2, Paris, pp. 153-250.
3. KORODI GAL, I. - 1957 - *"Studii ornithocenologice în câteva tipuri de păduri de foioase din Transilvania."* - St. Cercet. Biol. Acad. R.P.R., an. VIII, nr. 3-4, Cluj, pp. 319-329.
4. KORODI GAL, I. - 1964 - *"Rezultate ale cercetărilor cenologice asupra păsărilor din unele păduri de stejari şi păduri amestecate din câmpia Transilvaniei."* - Vert. Hung. Mus. Hist. Hung., Budapesta, tom. VI, fasc.1-2, pp. 41-71.
5. KORODI GAL, I. - 1968 - *"Rolul păsărilor în combaterea dăunătorilor pădurii."* - Rev. Pădurii, vol.82, nr.1, pp. 18-22.
6. KORODI GAL, I. - 1969 - *"Metode cantitative pentru studiul relaţiilor numerice ale populaţiilor de păsări."* - Rev. Muz., an. VI, nr.5, pp. 393-400.
7. MUNTEANU, D. - 1964 - *"Contribuţii asupra câtorva specii de păsări din bazinul montan al Bistriţei."* - An. Şt. Univ. Iaşi, Biol., fasc. 1, pp. 125-136.
8. MUNTEANU, D. - 1965 - *"Schiţă avifaunistică a bazinului montan al Bistriţei."* - An. Şt. Univ. Iaşi, ser. II, tom XI, fasc.1, Iaşi, pp. 103-121.
9. MUNTEANU, D. - 1968 -*"Cercetări asupra populaţiilor de păsări din bazinul Bistriţei (II). Aplicarea metodei traseelor în păduri de fag."* - Lucr. Staţ. Cerc. Biol. Geogr. "Stejarul", vol. I, pp. 359-365.
10. MUNTEANU, D. - 1968 - *"Observaţii ornitologice în Obcinele Bucovinei."* - Lucr. Staţ. Cerc. Biol."Stejarul", vol. I, pp. 367-374.
11. PAŞCOVSCHI, S. - 1956 - *"Un exemplu de constituire a biocenozei de pădure."* - Rev. Pădurii, an LXXI, nr. 1, Buc., pp. 5-8.
12. PASPALEVA, M., TĂLPEANU, M. - 1975 - *"Étude quantitative et calitative des peuplements d'oiseaux nicheurs dans une fôret de chenes."* - Trav. Mus. Hist. Nat. "Gr. Antipa", vol.XVI, Buc., pp. 265-280.
13. RANG, C. - 1990 - *"Factori stresanţi de origine antropică cu rol în diminuarea populaţiilor de păsări în arborete."* - Rev. Păd., nr. 3-4, Buc., pp. 166-168.
14. RANG C., CIORNEI C., CIUCĂ LĂCRĂMIOARA – 2003 - *„Evaluarea comunităților de animale cu impact asupra defoliatorilor din unele arborete de foioase din Podişul Central Moldovenesc”* – Studii şi Comunicări, Ed. Ion Borcea, Bacău, pp. 232–243.
15. RANG C., CIORNEI C., POPA N. - 2003 - *„Researches regarding birds communities from Romanian oak forests infested by defoliators”* - C.D. Ungaria, E-mail 5 p.
16. RANG C., LILIANA RANG, ANA MARIA CENUŞĂ, VIOLETA RANG - 2004 - *„Cercetări privind cunoaşterea hranei, pe baza conţinuturilor stomacale, la unele specii de păsări existente în colecţia Complexului Muzeal de Ştiinţele Naturii Bacău”* - Studii şi comunicări, Muz. Şt. Nat., Bacău, pp. 199 - 211.
17. RANG C., OLENICI N., ŢURCANU C., NEGURĂ A., LĂCRĂMIOARA ZAHARIA - 2004 - *„Evaluarea comunităţilor de păsări şi a impactului posibil al acestora asupra defoliatorilor şi xilofagilor din pădurile de răşinoase din bazinul Dornelor”* - Studii şi comunicări, Muz. Şt. Nat., Bacău, pp. 184 - 198.
18. RANG C., CIORNEI C., POPA N. - 2006 - *„Researches regarding birds communities from Romanian oak forests infested by defoliators”* - „Biotic damage in forests” Ungaria, - E-mail, C.D., pp. 316-321.
19. SIMIONESCU A., colab. - 2000 - *“Protecţia pădurilor”* - Ed. Muşatini, Suceava, 867 p.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 512 – 513

THE CERTIFICATION OF FOREST MANAGEMENT – A STEP FOR SUSTAINABLE DEVELOPMENT OF VANATORI NEAMT NATURE PARK AREA

SEBASTIAN CATANOIU, RAZVAN DEJU*

ABSTRACT

CATANOIU S., DEJU R., 2006 - The certification of forest management – a step for sustainable development of Vanatori Neamt Nature Park area. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 512-513.

The presence of the certified forests in the area of The Vanatori Neamt Nature Park (VNNP) shows the active preoccupation to conserve the ecological and social functions of the forest ecosystems. It also allows a superior use of the wooden and other forest products. Based on the experience achieved with this kind of certification, organic certification can be developed in VNNP’s area. This is very important in order to maintain the traditional activities and to provide a sustainable development of the area.

Key words: FSC, certification of forest management, Woodmark, biodiversity.

The Vanatori Neamt Nature Park (VNNP) was established in April 1999, as a subunit of Piatra Neamt Forest Branch. This protected area is included in “natural parks” category (V-th according IUCN) and cover a 30,818 hectares surface (from which 26,322 hectares forests) located in the northern part of Neamt County.

In 462/2001 Law, a natural park is defined like this:”natural area which goal is to protect and preserve some landscapes where the intermingle of human activities and nature, during the ages, created a peculiar area with a high cultural and landscape value, often with a high biodiversity. The management means to maintain the proper mix between human being and nature through conservation of habitats and landscapes, also keeping the traditional uses of land, local traditions and customs”.

One of the main goals of Vanatori Neamt Nature Park’s management plan is **forest management certification**.

The certification of forest management in Park area was a premiere in Romania. In June 2001 Woodmark–Soil Association from Great Britain, a FSC accredited forest certification organization, did the first preassesment of forest management for Varatec and Targu Neamt Forest Districts, using standards including over 200 definite indicators.

Some aspects were pursued:

- Respecting the laws (national and international)
- Deferring the rules for work protection
- Training of hired people
- Strategy and work schedule
- Monitoring of forest management and forest ecosystem
- Using information in management process
- Biodiversity conservation
- Stakeholders opinions and respecting their rights
- Respecting local traditions and cultural, historical, archeological, religious features.

The results of this evaluation were closely analyzed so the key elements and action fields resulted. A schedule was framed to achieve this goal, included actions, priorities, deadlines and responsibilities. A special care was given in order to harmonize the forest certification principles with local standards for forest management.

The main points of view regarded were:

- The relationship between biodiversity conservation and forest management plan
- Detecting the ecosystem and key species
- Cutting down the impact for forest operations

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- The correlation between local safety rules and the international ones , including providing safety equipment ,appropriate to the tasks of workers
- Using and recording the chemical substances
- Protection of endangered ecosystem
- Monitoring the major transportation roads.

In 2002, Woodmark Soil Association certified the management of Varatec Forest District and Targu Neamt Forest District in accordance with the requirements of the FSC. These standards and certification process could improve other interest areas:

- Emphasized the size regarding biodiversity conservation management
- Perfect monitoring system , analyzing and interpretation of monitoring results , using the conclusions in forest management plan
- Concern about protection of aquatic and fragile ecosystem
- Increase of forest companies responsibilities and interest regarding the protection of forest ecosystem
- Encouragement of wood purchasing only in a legal way.

In their final report, Woodmark experts emphasized that some aspects regarding biodiversity from certification point of view was solved because Park existing:

- Management plan of VNNP identifies FSC certification of the forest within the park as a key objective
- VNNP budget includes provision of management to benefit biodiversity
- Management plan includes an environmental impact assessment in relation with bison reintroduction
- VNNP has implemented biological surveys throughout the forest area
- VNNP staff is willing to incorporate the findings of research into future forest management plan and has a positive attitude towards such proposals from Forest District staff
- VNNP has a series of operational planning sheets which elaborate objectives into prioritized actions and can be used for monitoring process.

The forests inside Park may be considered to be a High Conservation Forest, there has been work carried out by the Forest park to asses stewardship of the high conservation attributes identified, to develop safeguards , management and monitoring for identified endemic plants, bird species under appendices II of the Bonn and Bern Conventions and management and monitoring of wolf, bear.

GIS mapping of other high conservation value attributes is also underway.

By way of conclusion, the forest certification must be supported for respecting legislation (harmonisation of existing laws, instructions with principles and criterias of certification bodies). In order to be efficient, certification must be extended on the horizontal level (by increasing of certified areas and certified products) and on the vertical level (certification of exploitation, processing and sales firms) having as main goal public awareness at the national level for establishing autochthonous consumer of certified products.

Rezumat

Prezența certificării forestiere în zona Parcului Natural Vânători Neamț reflectă o preocupare activă pentru conservarea funcțiilor ecologice şi sociale ale ecosistemelor forestiere. De asemenea, certificarea forestieră permite o utilizare superioară a lemnului cât şi a altor produse forestiere.Un aspect important îl reprezintă menținerea activităților tradiționale cât şi dezvoltarea durabilă a zonei.

References

1. WWF, 1999 - Newsletter regarding forest certification
2. NĂSTASE L., WHITFIELD PH., 2004 - Woodmark Forest Certification Monitoring Report Vanatori Neamt Nature Park.

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STUDII ŞI COMUNICĂRI 2006	Vol. 21: 514 – 518

PART III - HIDROLOGY, HIDROBIOLOGY

THE PREVENTIONS AND CONTROLS MEASURES OF THE RAINFALL REGIME VARIATION (HIGH OR LOW) ISSUE, ON THE DAMMED AND DRAINAGED AREA OF DANUBE DELTA BIOSPHERE RESERVE

VALENTIN PANAIT*

ABSTRACT

PANAIT V., 2006 - The preventions and controls measures of the rainfall regime variation (high or low) issue, on the dammed and drainaged area of Danube Delta Biosphere reserve. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 514-518.

The purpose of this study is to present sever aspects regarding by the way in which climatic changes in the last few years may influence soil's fertility.

From among of the climatic factors, with impact on the soil's characteristics, the rainfall regime and rainfall regime variation, especially one, its have been choosing. In this purpose, we chose the soil's cover of the Murighiol-Dunavăţ agricultural precinct as a reference model. Within this area, we followed the potential impact of rainfall variation regime (high or low) on the mechanical, physical and chemical properties of the soil.

In the actual conditions the soils fertility is very good but, in order to preserve these, we should use the improvements works to control the degradation processes of the soil's parameters. These can be splits in two categories, as follows:

1. **The short term measures** chase the reconstruction of the drainage canals and unclogging of them, as well as the Lipovenilor canal in the frame of Murighiol-Dunavăţ dammed area. These solutions were established considering the history of that area and in order to improve the soils hydratation and the swelling degree, as well as the stagnation of the soil's degradation processes. In that case, a good fertility of the soils cover will be maintained in the future on an average period of 10 years.

2. **The long term measures** chase a controlled breakage of the dams and a slow flooding of that dammed area (starting with the low level areas and finishing with the high level ones). These measures will taken the Murighiol-Dunavăţ dammed area back to the natural regime on a period that can be settled depending on the restoration speed of that

Key words: soil, reconstruction works, rainfall, Murighiol-Dunavăţ dammed area

Introduction

The purpose of this study is to present sever aspects regarding by the way in which climatic changes in the last few years may influence soil's fertility.

From among of the climatic factors, with impact on the soil's characteristics, the rainfall regime and rainfall regime variation, especially one, its have been choosing. In this purpose, we chose the soil's cover of the Murighiol-Dunavăţ agricultural precinct as a reference model. Within this area, we followed the potential impact of rainfall variation regime (high or low) on the mechanical, physical and chemical properties of the soil.

The Murighiol-Dunavăţ dammed area is situate on the eastern side of the Tulcea Hills and bordered by Sf. Gheorghe branch at the north, Dunavăţ channel at the east and Dunavăţu de Jos channel at the south. (Romanescu, 1996)

The selection was not made randomly, because this agricultural precinct with a high agricultural potential is included (on an ecotone area) in the frame of the Danube Delta Biosphere Reserve. This reserve has been included, according to the data available on web site of F.A.O. – U.N.E.S.C.O.

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(www.fao.org), in the category of the lands affected by drought.

Material and method

The necessary stages for the achievement of the work are:

- ⇨ documents concerning the initial state of Murighiol-Dunavăț unit, shown in the data offer by specialists from: I.S.I.P.I.F. Bucureşti, I.C.P.A. Bucureşti, D.D.N.I. and O.J.S.P.A. Tulcea, in the scientific literature, as well as in reports and/or the technical projects elaborated on the occasion of the damming works and draining works;
- ⇨ studying the cartographical and cadastral materials, establishing the way to follow in order to draw the sampling itineraries, as well as the actual legislation and the scientific literature, concerning the legal situation and the present day status of the different land areas from the precincts;
- ⇨ data concerning the climatic factors evolution and the rainfall regime, especially one;
- ⇨ performing land observation, profiles opening and samples drawing at the soil horizon level;
- ⇨ results centralization, evolution analysis and comparison between obtained data with those found in the scientific literature, as well as in other previous published papers.

Results and discussions

In this paper there were used data from the Permanent site for soil studies number 3, recorded between 1976 and 2000 years. In this period there were analyzed three types of soils, as follows: Gley soil typical (1976 year); Gley soil alluvial carbonate (1995 year); Gley soil alluvial carbonate, emergent ripen, low salinized, low alkalinized (2000 year).

Because, within the one of the largest soil territorial units we established the Permanent site for soil studies number 3, therefore we used the data collected from that point.

Using the evolution of rainfall regime (the multiannual and monthly), from these three meteorological stations, as follows: Tulcea, Gorgova and Sf. Gheorghe (Fig. 1), was identified the rainfall evolution on the Murighiol-Dunavăț dammed area (See Figure 2). The evolution of the rainfall variation regime offers a platform for the some soil parameters evolutions and can be used to anticipate the evolution of the soil cover. (Puiu., 1980)

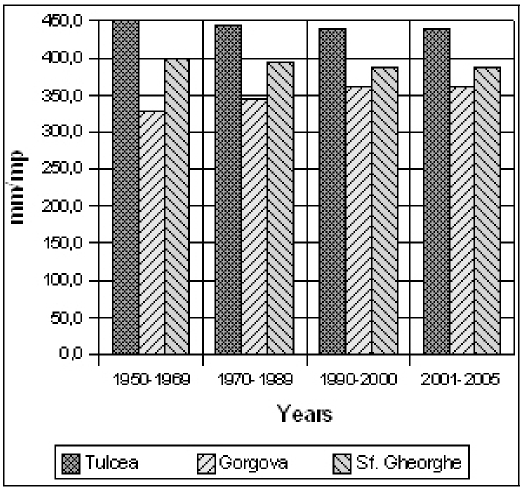

FIG. 1 – The multiannual average value of rainfall

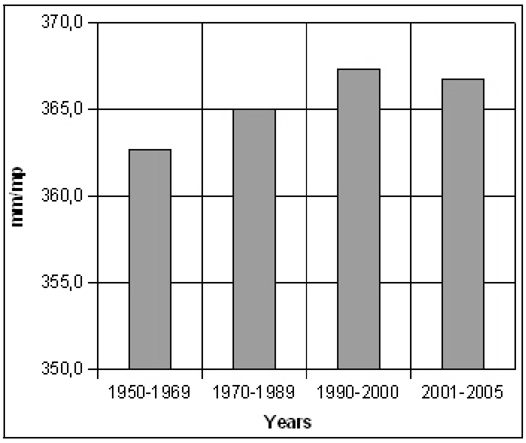

FIG. 2 – The month average value of rainfall on the Murighiol-Dunavăț dammed area

In order to understand the evolution of the soils cover, we were used the data concerning the climatic condition of Danube Delta. The meteorological aspects of this area are characterized by the mean multiannual temperature, thus being registered between ~12,9 ^{o}C in Tulcea and ~12,15 ^{o}C in Sf. Gheorghe, as well as the rainfall regime, were measured between ~435 mm in Tulcea and ~335 mm Sf. Gheorghe. In these conditions, the potential evapotranspiration has a value of ~700 mm. These meteorological conditions, on the long term, can lead to occurrence of the aridization processes.

Within these climatic conditions, we added the data concerning the actual climatic changes. Those can lead to the high monthly variation of the rainfall regime. In that case, the evolution of the soils cover was monitored on the two aspects, as follows:

1.the general trends – under the rainfall variable regime (Table 1);

2.punctual variations – under the rainfall monthly regime (Table 2, 3).

Tab. 1 - The general trends evolution of some of the soil properties under the rainfall variable regime (after Puiu, 1980)

The soil properties	**The general trends**
Texture	That could cause a mineralization of the clay (that could decrease the clay concentration) and an increase of the sand (course and fine) concentration, on the soil profile; as well as the soil aggregates are cover with dust.
Density	That could cause a decrease of the soil density and an increase of the total porosity.
Compaction degree	That could increase the soil compaction degree, only in the case of the wetland soils.
Humus	That could cause a loose of the coagulation cations (Ca^{2+} and Mg^{2+}) and the clay-humus complex depletion of the bases.
Soil solution	That could grow the concentration of the soil solution
Organic matter	That could cause an increase of the aerobic degradation.
pH	That could increase the soil alkalinity.
Total soluble salts content	Within soil profile, that could cause a precipitation and an increase of the soluble salts concentration.

Tab. 2 - The punctual variations of some of the soil properties under the rainfall monthly regime (after Puiu, 1980)

The soil properties	**High**
Temperature	That could cause an increase of the thermal conductivity and a decrease of the soil temperature.
Structure	That could swell the soil aggregates, as well as turn them into a paste and bogging up phenomenon occurring.
Humus	That could cause a loose of the coagulation cations (Ca^{2+} and Mg^{2+}) and the clay-humus complex depletion of the bases.
Soil solution	That could grow the dilution degree of the soil solution.
Organic matter	That could cause an increase of the anaerobic degradation.
pH	That could increase the soil acidity.

Tab. 3 - The punctual variations of some of the soil properties under the rainfall monthly regime (after Puiu, 1980)

The soil properties	**Low**
Temperature	That could cause a decrease of the thermal conductivity and an increase of the soil temperature.
Structure	That could cause the shrinkages of the soil aggregates and the occurrence of the cracks in the soil.
Humus	That could cause a loose of the coagulation cations (Ca^{2+} and Mg^{2+}) and the clay-humus complex depletion of the bases.
Soil solution	That could grow the concentration of the soil solution.
Organic matter	That could cause an increase of the aerobic degradation.
pH	That could increase the soil alkalinity.

The soil evolution was measured using three types of soils that were identified within the Permanent site for soil studies number three, as follows: Gley soil typical (1976 year); Gley soil alluvial carbonate (1995 year); Gley soil alluvial carbonate, emergent ripen, low salinized, low alkalinized (2000 year). The evolution in time of the soils cover was compared on each time interval, in order to achieve a good evaluation of the soil natural fertility.

A good indicator for the soil natural evolution and the lowest limit of soil fertility, as well as the restrictive factors, is the difference between the properties of the Gley soil typical, Gley soil alluvial carbonate and Gley soil alluvial carbonate, emergent ripen, low salinized, low alkalinized.

The study of the soil properties (physical, mechanical and chemical) evolution prove this progressive reduction of the essential elements concentrations, as well as a increase of the degradation processes of the some soil characteristics. Several of the threats (for the soil characteristics) are follows: secondary salinization (~ 900 mg salts/100 g soil), increasing of the compaction degree, decreasing of the organic matter concentration and the subsidence processes. These lead to the decrease of the soil fertilities, the agriculture capabilities and the spontaneous vegetation dynamics. Fortunately, these processes have a slow evolution and are not a threat for the soils fertility.

Conclusions

In the actual conditions the soils fertility is very good and that can be maintain in the future. However, in order to preserve the soil fertility, we should use the improvements works to control the degradation processes of the soil's parameters. These can be splits in two categories, as follows:

1. **the short term measures**;
2. **the long term measures**.

1. **The short term measures** chase some objectives: the reconstruction of the drainage canals and unclogging of them, as well as the Lipovenilor canal in the frame of Murighiol-Dunavăț dammed area.

The necessary stages (Table 4), for preserving that area, for the agricultural purposes, are follows:

- ⇨ the reconstruction of the access away – for the terrestrial transport of the matters or workmen;
- ⇨ starting the spade works, as follows: the land leveling – created space for deposit of the matters and technics, telecommunications, cabins, landmark;
- ⇨ the reconstruction of the hydrological wells – this could be using for measure the level and the physico-chemical characteristics of the ground water;
- ⇨ the reconstruction of the drainage system – that types of works can be split in the following steps:
  1. reconstruction of the Lipovenilor canal – that aim at: reopening (between Dunavățu de Jos – on the first stage and Sf. Gheorghe arm – at the end), unclogging and excavating to 1 m of that canal;
  2. reconstruction of the main drainage canals – that aim at:
     - assuring the link between Lipovenilor canal and Dunavăț canal, on eastern part of that area and between Lipovenilor canal and the eastern side of the Tulcea Hills;
     - assuring an optimal distance between drainage canals of 1 or 2 km, as well as excavating to 0,6 m of its;
  3. reconstruction of the secondary drainage canals (as the connection canals between each of the main drainages canals) – the optimal distance between the canals of 1 or 2 km, and a depth to 0,5 m;
- ⇨ the land improvement works – these should assured a maintenance of the soil fertility, that aim at:
  - ▪ the springtime plowing on medium depth and the finely disking the soil (these can stop the natural leaching and drying of the soil – in function of the rainfall intensity);
  - ▪ the autumns plowing on medium depth that can stop the natural leaching of the soil). (after Măianu, 1964)

Tab. 4 - The type of the works category.(after "Amenajarea complexă a unitații Murighiol-Dunavăț județul Tulcea", 1983)

No	WORKS CATEGORIES	Cost (RON)
1.	Lands leveling	1.539.306
2.	Lands improvement	6.540.558
3.	Access away	2.528.431
4.	Lipovenilor canal reconstruction	820.300
5.	Main drainage canals reconstruction	9.576.132
6.	Secondary drainage canal reconstruction	8.203.00
7.	Telecommunications	67.532
8.	Cabins	635.583
9.	Landmark	16.553
10.	Hydrological wells	74.813
Total:		21.799.208

These solutions were established considering the history of that area and in order to improve the soils hydratation and the swelling degree, as well as the stagnation of the soil's degradation processes. In that case, a good fertility of the soils cover will be maintained in the future on an average period of 10 years.

2. **The long term measures** chase a controlled breakage of the dams and a slow flooding of that dammed area (starting with the low level areas and finishing with the high level ones). These measures will taken the Murighiol-Dunavăț dammed area back to the natural regime on a period that can be settled depending on the restoration speed of that.

Rezumat

În contextul evoluției nivelului precipitațiilor din ultima perioadă, studiul parametrilor fizici, mecanici şi chimici, ai solului a scos în evidență o reducere progresivă a concentrațiilor principalelor elemente nutritive, o intensificare a proceselor de degradare şi implicit o diminuare a fertilității solului.

Pentru contracararea proceselor de degradare a caracteristicilor solurilor, ce au dus la instalarea unor fenomene de salinizarea secundară, alcalinizare (pe cea mai mare parte din suprafața incintei), acidifiere (in zone limitrofe canalelor de drenaj), tasare şi subsidență a solurilor, s-au impus două categorii de soluții:

- <u>Soluții pe termen scurt</u>. Scopul acestora fiind de a asigura un regim hidric corespunzător şi stoparea fenomenelor de tasare şi salinizare a solurilor. Durata medie de timp, pentru care se poate garanta o producție bună la hectar, este de 10 ani.
- <u>Soluții pe termen lung</u>. Spargerea controlată a digurilor şi inudarea treptată a incintei, până la readucerea completă a zonei sub regim natural pentru o perioadă de 20 sau 30 de ani. Peroada de timp poate fi stabilită în funcție de viteza cu care se reface zona.

References

1. MĂIANU AL., 1964 - *Salinizarea secundară a solului*. Editura Academiei Republicii Populare România, Bucureşti
2. PUIU ŞT., 1980 – *Pedologie*. Editura Ceres, p. 84, Bucureşti.
3. ROMANESCU GH., 1996 - *Delta Dunării – Studiu morfohidrografic*. Editura Corson, pp. 130, Iaşi.
4. * * * *Amenajarea complexă a unitații Murighiol-Dunavăț județul Tulcea*. Vol. 1-12, arhivele I.S.P.I.F. Bucureşti, 1983.

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

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A MULTIMETRIC APPROACH TO THE BENTHIC MACROINVERTEBRATE FAUNA ON THE CIOBANUS-BACAU RIVER COURSE

FLORIAN PRISECARU , DELIA GHEORGHE, DAN DASCALITA*

ABSTRACT

PRISECARU F., GHEORGHE D., DASCALITA D., 2006 - A multimetric approach to the benthic macroinvertebrate fauna on the Ciobanus-Bacau river course. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 519-523.

The Ciobanus River is a right affluent of the Trotus River with a basin of 132 km^2. A study was made on biological attributes of this river course over the years 2004, 2005, 2006. The biological indexes obtained show that the Ciobanus River attains a high-quality water (can be graded as very good). This is due to the fact that this river is situated in the mountainous area without pollution sources.

Key words: benthic macroinvertebrate, multimetric approach, the Ciobanus River

Introduction

The Ciobanus River is a right affluent of the Trotus River with a basin of 132 km^2 (Fig.3). The altitude in the section is of 465 m, at an angle of 24%, multi-annual average flow: Qm: 1.30 m^3/s and the average minimum monthly flow every year 95% $Q_{95\%}$: 0,009.

The structure of the river bed in the sampling site is: cobble, gravel and sand.

Material and methods

A study was made on biological attributes of this river course over the years 2004, 2005, 2006.

In the period 2004-2006, there have been collected seven water samples as follows (Figs. 1-2):

- two water samples in 2004 (2nd and 3rd quarter of the year, respectively in June and August);
- two water samples in 2005 (2nd and 3rd quarter, respectively in June and August);
- three water samples in the 2nd, 3rd and 4th quarters (May, August and October).

These water samples were taken by using a Surber sampler. These quantitative samples of macroinvertebrates from shallow streams were of composed type (at least one sampler from all the types of water substrates; in mixing up all the sub-samples, there resulted a single assay-sample).

Four to eight samplers were examined, depending on substrate. The material was preserved with formalin; it was partially selected on field surveys and totally analysed in the lab. After selection, the macroinvertebrates were stored and preserved with a 70% alcohol solution. The identification of the material was performed in an alcohol medium with glicerin. All maps have been made with ARCMAP 9.0 (ESRI).

1. **The saprob index:** the Pattle Buck index is calculated using the list of saprob valencies according to the 161/2006 Act. The calculus formula is:

$$S = \frac{\sum (s_i * h_i)}{\sum h}$$

where:
s = numerical value characteristic of its belonging to the saprob area
h = frequency of organisms
i = taxon
$\sum (s_i * h_i)$ sum of the products between the numerical value and the frequency for each taxon
$\sum h$ = sum of frequencies of identified taxons

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2. **Biological monitoring working party score** (BMWP) – provides information on the tolerance to pollution, the identifications being performed on macroinvertebrate family data (for Oligochaeta on order data). The lower the score is, the higher the degree of tolerance. This score is obtained by summing up all values in the BMWP table score – Table of BMWP Score Armitage et al.1983.

3. **Average score per taxon** (ASPT) – is calculated by division of the BMWP value by the number of families in the sample.

4. **The Simpson index of diversity** – its values range between 0 and 1; the closest these values are to 1, the higher the degree of diversity. It is calculated upon the formula:

$$\mathbf{D= 1\text{-}\sum^{s} (P_i)^2.}$$

where: D = bio-diversity index
P_i = the proportion in which the "i" taxon is represented in the biocenosis (the ratio between the number of individuals or the density by which the "i" taxon is represented/total number of individuals or total density in the sample); S = total number of taxons.

EPTt – The index for Ephemeroptera, Plecoptera, Trichoptera (EPT) indicates the taxonic density within the groups of insects considered sensitive to pollutants; therefore, this index must increase along with the improvement in water quality. Initially used in identification at the species level, this index is also available at the family lavel (Plafkin et al., 1989). The EPT index of a stream represents the total number of families within the three genera from the sample.
EPTTi – represents the number of Ephemeroptera, Plecoptera, Trichoptera identified in the sample.

The EPT – Chironomidae ratio represents the equilibrium of the organisms
Since these orders of macroinvertebrates are highly sensitive to pollution, EPT are often used as water quality indicators. Their presence indicates a high quality of water, while their absence suggests water may be polluted. Because the Chironomidae are the least sensitive to pollution, this ratio is calculated in dividing the total number of EPT species by the total number of midges.

Results and discussions

As a result of the sampling of biological material and of its identification, there have been obtained the results registered in the following table:

Sampling date	List of species and the saprob area indicated	Number of individuals per sample	Saprob Index	BMWP	ASPT	Simpson index	EPTT		EPTi		EPT / Chir
							Nr	%	Nr	%	
3.06.2004	**Classa Insecta Ord. Ephemeroptera Fam. Heptageniidae**		1..5	28	7	0.518	6	100	19	100	0
	Heptagenia flava β										
	Ecdyonurus sp. o-β										
	Rhitrogena semicolorata x										
	Fam. Caenidae										
	Caenis horaria o										
	Fam. Batidae										
	Baetis vernus β										
	Ord. Trichoptera Fam Limnephilidae										
	Limnephilus extricatus o-β										
19.08.2004	No zoo-benthonic organisms identified										
4.06.2005	**Class Insecta Ord. Ephemeroptera Fam. Heptageniidae**		1.49	43	6.14	0.71315	8	88.8	77	91.6	0
	Ecdyonurus venosus o-β	41									
	Heptagenia flava β	4									
	Epeorus alpicola x-o	2									
	Fam. Batidae										
	Centroptilum pennulatum o-β	9									
	Ord. Plecoptera Fam. Leucridae										
	Leucra nigra o-β	4									
	Fam. Nemouridae										
	Protonemura meyeri x	2									
	Ord. Trichoptera Fam Hydropsychidae										

	Hydropsyche instabilis x-o	13									
	Fam. Polycentropodidae										
	Plectrocnemia conspersa x-o	2									
	Ord Diptera **Fam. Chaoboridae**										
	Chaoborus sp.o-p	7									
	Class Insecta **Ord. Ephemeroptera** **Fam. Heptageniidae**										
	Heptagenia flava β	4									
	Electrogena lateralis o	12									
	Fam. Batidae										
	Cloeon dipterum o-α	76									
	Baetis vernus β	16									
25.08.2005	**Fam. Ephemerellidae**		1.86	33	5.5	0.677469	6	75	120	83.3	6
	Ephemerella ignita o-α	8									
	Ord. Trichoptera **Fam Rhyacophilidae**										
	Rhyacophyla dorsalis o	4									
	Ord Diptera **Fam. Chironomidae**										
	Centroptilum pennulatum β	20									
	Fam. Athericidae										
	Atherix ibis o	4									
	Class Insecta **Ord. Ephemeroptera** **Fam. Heptageniidae**										
	Heptagenia sulphurea β	51									
	Heptagenia coerulans β	5									
	Ecdyonurus helveticus x	3									
	Ecdyonurus alpinus o	1									
	Ecdyonurus venosus o	1									
	Ecdyonurus zelleri x	1									
29 05 2006	**Fam. Batidae**										
	Baetis rhodani β	25									
	Baetis vernus β	6									
	Baetis spp. (stadii larvare mici) β	4									
	Ord. Plecoptera **Fam. . Perlidae**										
	Perla marginata x	2									
	Fam. Perlodidae		1.78	51	5.1	0.787598	14	82.3	113	88.2	16.1
	Isogenus nubecula β	6									
	Fam. Chloroperlidae										
	Chloroperla montana o	4									
	Ord. Trichoptera **Fam Hydropsychidae**										
	Hydropsyche instabilis x-o	3									
	Fam. Glossosomatidae										
	Glossosoma spp. o	1									
	Ord Diptera **Fam. Chaoboridae**										
	subfam. Orthocladiinae										
	Orthocladius spp. o- β	7									
	Fm. Athericidae										
	Atherix ibis x-o	1									
	Fam. Blepharoceridae										
	Liponeura cinerascens x-o	7									
1.08.2006	**Class Crustacea** **Ord. Amphipoda** **Fam. Gammaridae**		1.67	61	6.7	0.75865	7	58.3	68	91.1	68
	Rivulogammarus balcanicus	5									
	Class Insecta **Ord. Ephemeroptera** **Fam. Heptageniidae**										
	Ecdyonurus helveticus	11									
	Fam. Batidae										
	Baetis buceratus	29									
	Baetis rhodani	2									
	Baetis spp.	10									
	Fam. Caenidae										
	Caenis macrura	1									
	Ord. Trichoptera **Fam Rhyacophilidae**										
	Rhyacophila vulgaris	4									
	Fam. Hydropsychidae										
	Hydropsyche siltalai	1									
	Ord. Plecoptera **Fam. Perlodidae**										
	Perlodes spp.	1									
	Fam. Chloroperlidae										
	Chloroperla montana	1									
	Chloroperla torrentium	2									
	Ord. Diptera **Fam. Chironomidae**										

	subfam. Tanypodinae										
	Thienemannimyia spp.	1									
	Cls. Crustacea **Ord. Amphipoda** **Fam. Gammaridae**										
	Rivulogammarus balcanicus	7									
	Cls. Insecta **Ord. Ephemeroptera** **fam. Baetidae**										
	Baetis alpinus	7									
	Baetis buceratus	5									
	Baetis rhodani	9									
	Fam. Heptageniidae										
	Ecdyonurus alpinus	4									
	Ecdyonurus helveticus	1									
	Ecdyonurus venosus	2									
	Heptagenia coerulans	13									
	Fam.Caenidae										
17.10.2006	Caenis macrura	2									
	Ord. Plecoptera **Fam. Perlidae**		1.44	61	5.08	0.9134	15	83.3	161	76.6	16.1
	Perla marginata	3									
	Fam. Perlodidae										
	Isogenus nubecula	1									
	Fam. Chloroperlidae										
	Chloroperla montana	2									
	Chloroperla torrentium	4									
	Ord. Trichoptera **Fam. Rhyacophilidae**										
	Rhyacophila vulgaris	3									
	Fam. Hydropsychidae										
	Hydropsyche instabilis	2									
	Fam. Glossosomatidae										
	Glossosoma spp.	3									
	Ord. Diptera **Fam. Blepharoceridae**										
	Liponeura cinerascens	2									
	Fam. Chironomidae										
	subfam. Orthocladiinae										
	Orthocladius spp.	10									

The biological indexes obtained show that the Ciobanus River attains a high-quality water (can be graded as very good). This is due to the fact that this river is situated in the mountainous area without pollution sources.

Conclusions

Along the course of the Trotus River, there are no considerable pollution sources which can have an impact on the water and the natural aquatic media (the biocenoses of benthic macroinvertabrates). The lack of pollution sources determines the classification of the river among the high quality water resources (first class in water quality according to Order 161/2006).

The ecological status of the entire water course is good and totally corresponds to the requirements of the EU Water Framework Directive (60/2000).

All along its course, there are no hidromorphological changes which might prevent migration from its source towards its confluence with the Trotus River and viceversa.

As a conclusion of the elements presented in this paper, we can assert that the Ciobanus River is rightfully classifed as a typical mountainous river, whose sections analysed along its entire course, from its spring to its mouth, can be considered to be reference sections, with good water quality, wihout any changes.

References

1. MALACEA I., 1969 – *Biologia apelor impurificate*. Editura Academiei Române.
2. *** 1984 – *Îndrumar metodologic pentru urmarirea evoluției calității apelor, prin intermediul analizelor biologice* . C.N.A Institutul de Cercetări şi Proiectări pentru Gospodarirea Apelor, Bucureşti.
3. *** *Directiva cadru a Apelor* – UE 60/2000 (* * * Water Framework Directive – UE 60/2000).

Fig. 1

Fig. 2

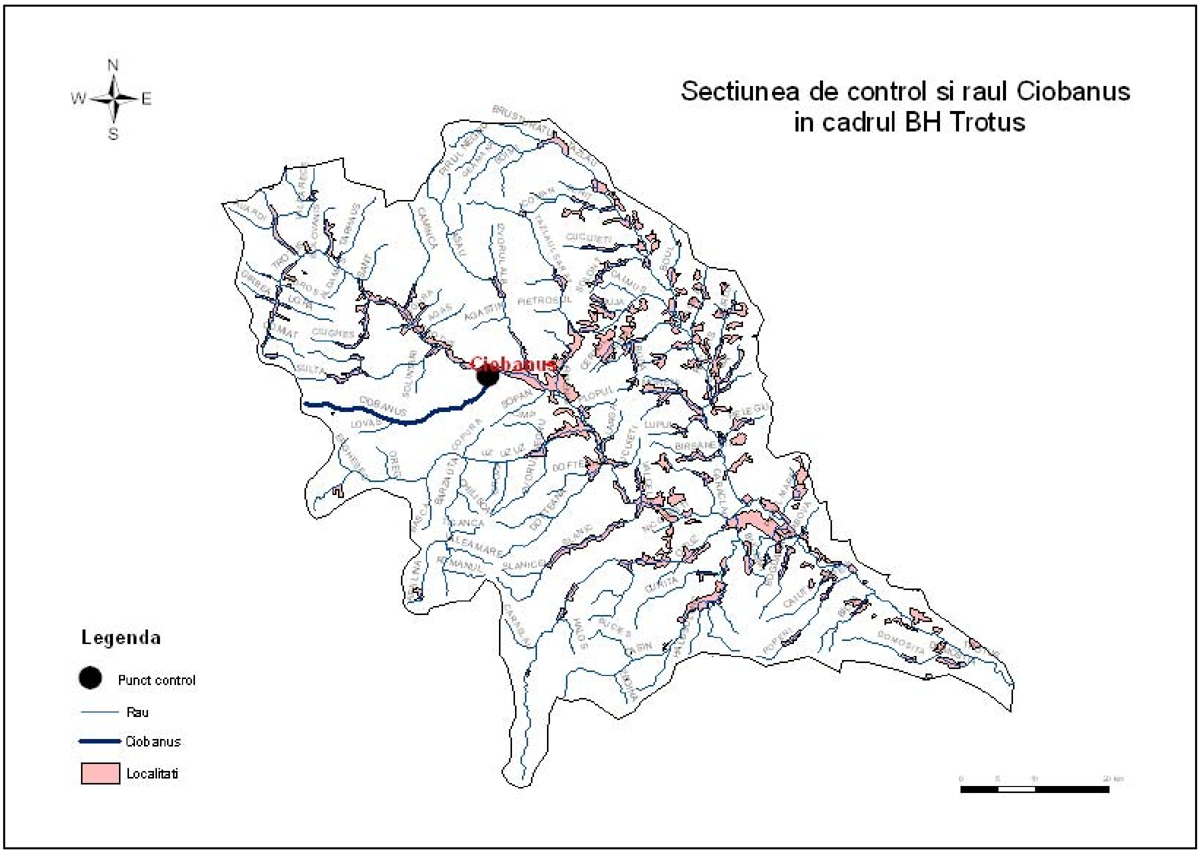

Fig. 3

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 524 – 530

OBSERVATIONS ON THE VARIABILITY OF WATER QUALITY CLASSES OF THE TROTUS RIVER ACCORDING TO THE SAPROB INDEX

FLORIAN PRISECARU, DAN DASCALITA, DELIA GHEORGHE*

ABSTRACT

PRISECARU F., DASCALITA D., GHEORGHE D., 2006 - Observations on the variability of water quality classes of the Trotus river according to the saprob index. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 524-530.

The Trotus River is a right affluent of the Siret River, with a total length of 162 km. Eight samplings of benthic macroinvertebrates have been performed in the five sampling points (Ghimes, Darmanesti, Tg Ocna, Vranceni and downstream Adjud) over the years 2003-2006.

Key words: benthic macroinvertebrates, saprob index, the Trotus River, sampling points

Introduction

The Trotus River is a right affluent of the Siret River, with a total length of 162 km. It rises from the Ciuc Mountains at an altitude of 1360 m and crosses the Tarcau, the Gosman and the Berzunti Mountains.

Along its course, there are a series of depressions and its valley is narrawing to the point of a gorge. In its upper section, the Trotus changes course from the south-north to the south-east, in the section Ghimes – Faget; it keeps this course up to its flowing into the Siret, downstream of Adjud.

The hidrographic basin of the Trotus has a surface of 4456kmp and an average altitude of 706m; it represents the area from which this river and its affluents collect waters from pluvial, nival and subterraneous sources. At its confluence with the Siret River, its average flow is of 36.0mc/s.

In the mountain area, it has two left tributaries, Valea Rece and Asău, and five right tributaries: Sulta, Ciobanuş, Uz, Dofteana, Slănic.

In the Subcarpathian area, the Trotus flows together with three rivers whose source is in the mountain region: Oituz, Casin, Tazlau.

In the piedmont area, there are two other rivers that flow into the Trotus: Caiuti and Domosita. The most imporatant affluents/tributaries of the Trotus River are: Uz (S=443kmp, L=45km), Slanic (S=126kmp, L=28km), Oituz (S=332kmp, L=59,5km), Caşin (S=307kmp, L=4,5km), Tazlău (S=10,93kmp, L=85,3KM).

Due to its geographical position, the Trotus Basin has been modelled especially in the Carpathian and Subcarpathian areas, its lower course advancing to the limit of the Moldavian Plateau and of the Romanian Plain.

The main relief forms belong to the mountain and Subcarpathian areas, and only a small section at the confluence with the Siret River overlaps the Inferior Siret Plain.

The Trotus Basin belongs to the temperate continental slightly moderate climate. The average annual temperature ranges from 9.5 ^{0} C in Adjud, 9.4^{0}C in Brusturoasa to 1-2^{0}C on the peaks. The monthly minimum temperatures vary from (-2)-(-3)^{0}C in January (-2,1^{0}C at Tg. Ocna, -2,8^{0}C at Adjud) and (-6^{0}C)-(-7^{0}C) on the peaks, and the maximum temperatures vary between 20-21^{0}C in the lower course (20,2^{0}C July, in Tg. Ocna) and 10-12^{0}C in the upper course. At the Toaca Peak, the average temperature of the summer months (July – August) is 9.2^{0}C. As far as the extreme temperatures are concerned, their values are: minimum :26,7^{0}C at Tg. Ocna (14.01.1985) and -30^{0}C on the peaks ; maximum :38,6^{0}C at Tg. Ocna (25.07.1987) and 20-22^{0}C in the highest regions. Much relevance is attached to the duration of the interval with minimum temperatures below 0^{0}C. While in Tg. Ocna, the number of months in which the freezing point is not reached is of three (June, July, August), at the highest altitudes, this risk is almost permanent.

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The level of precipitations represents the most important element in the formation of torrents and of the side effects that they induce. The quantity of precipitations depends on the humidity of the air masses, the geographical position and the altitudes. The perpendicular position of the ranges of mountains in relation with the western air circulation leads to lower monthly parameters in the area of „sheltered" mountains known as « muncei ». The average multi-annual quantities range from 528.8l/mp in Adjud, 583.5l/mp in Tg.Ocna, 571.6l/mp in Brusturoasa to 800-1000l/mp on the top of the mountains. These quantities are lower in autumn and in winter (25-40l/mp) and higher in June and July (90-100l/mp). Over the summer period, the water quantity fallen at short intervals is also relevant. (24 h). It is the case of torrential rains fallen during the night of July 28/29 1991, in the sub-basin of the Tazlau River. There have been registered 186l/mp at Orasa-Livezi, but data processing of the parameters of the Tazlau affluents indicated the possibility of local precipitations exceeding 200-500l/mp.

These parameters were: 120l/mp at Paltinis-Asau, 116.4l/mp at Asau, 156,7l/mp at Moineşti, 160.8l/mp at Solont, 131l/mp at Tazlau, 160.8l/mp at Bucsesti, 180.5 l/mp at Strugari, 158.6l/mp at Berzunti, 176.7l/mp at Haghiac-Dofteana, 140.2l/mp at Slanic, 113,8l/mp at Gura Vaii, 106.3l/mp at Onesti, 100.2l/mp at Casin, 110.7l/mp at Onesti,etc.

Material and methods

DESCRIPTION OF SAMPLING POINTS

The Trotus River has been studied in five sampling points: Ghimes, Darmanesti, upstream Tg Ocna, Vranceni, downstream Adjud.

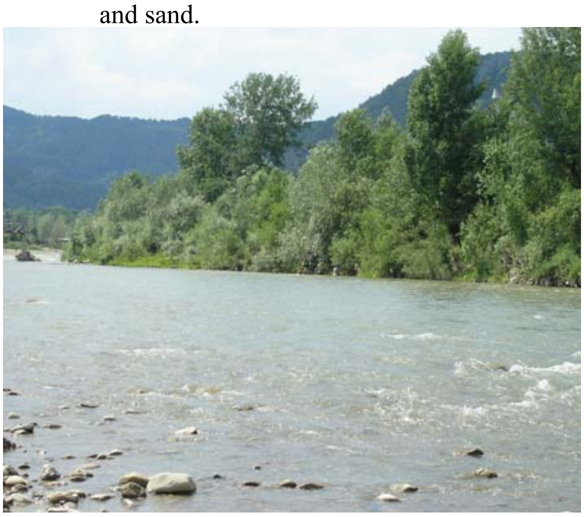
Name of sampling point: Ghimes
Surface: 383 km^2
Altitude: 1116 m
Inclination of slope: 20 ‰
Multiannual average flow Qm: 3.54 m^3/s
Minimum average month flow rate/year 95% $Q_{95\%}$: 0.34 m^3/s
Structure of the river bed: cobble, gravel and sand.

Trotus – Ghimeş

Name of sampling point: Darmanesti
Surface: 1750 km^2
Altitude: 970 m
Inclination of slope: 14‰
Multiannual average flow Qm: 14.8 m^3/s
Minimum average month flow rate/year 95% $Q_{95\%}$: 1,57 m^3/s
Structure of the river bed: cobble, gravel and sand.

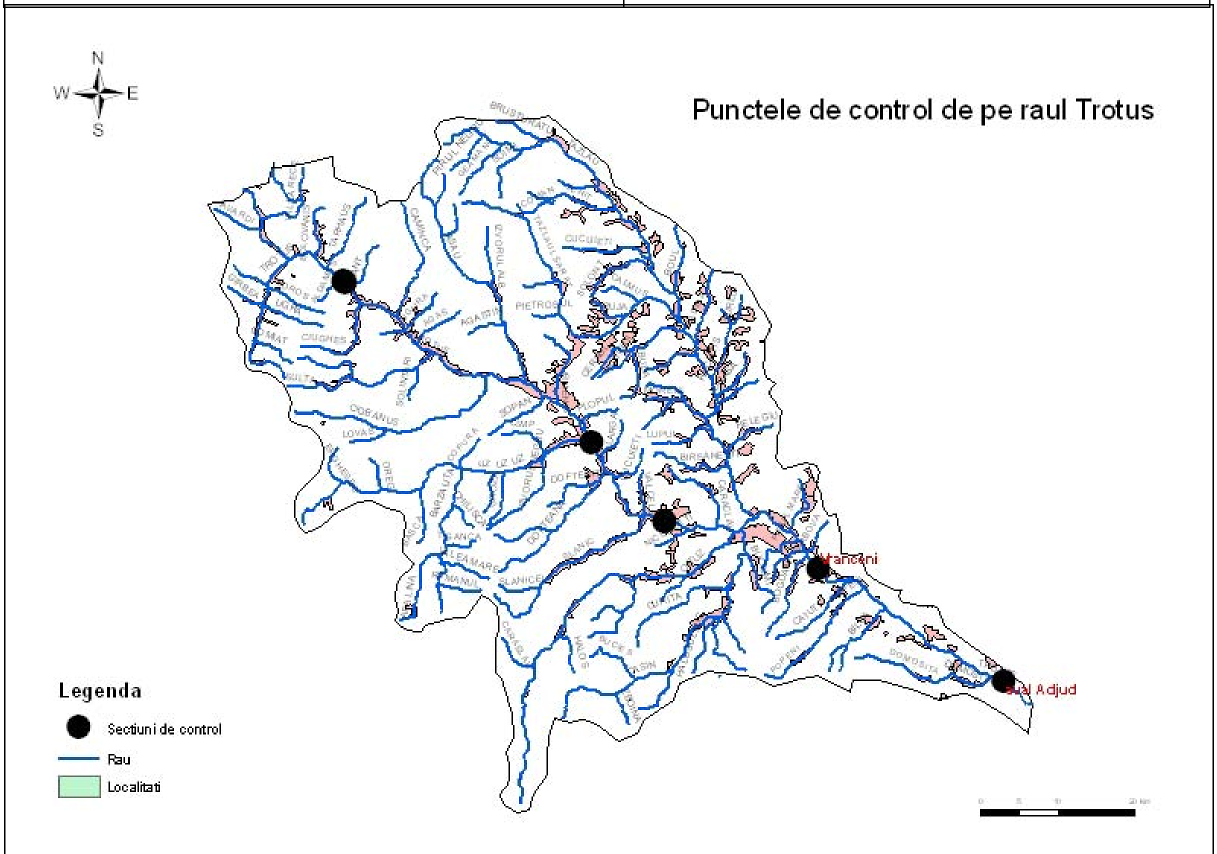
Trotus Darmanesti

Name of sampling point: Tg Ocna
Surface: 2091 km^2
Altitude: 246m
Inclination of slope: 4 ‰
Multiannual average flow Qm: 17.4 m^3/s
Minimum average month flow rate/year 95% $Q_{95\%}$: 1.8 m^3/s
Structure of the river bed: cobble, gravel and sand.



Trotus – Tg Ocna

Name of sampling point: Vranceni Surface: 4077 km^2 Altitude: 159m Inclination of slope: 1.5 ‰ Multiannual average flow Qm: 34.9 m^3/s Minimum average month flow rate/year 95% $Q_{95\%}$: 3.4 m^3/s Structure of the river bed: cobble, gravel and sand.	Name of sampling point: downstream Adjud Surface: 4456 km^2 Altitude: 83m Inclination of slope: 1.5 ‰ Multiannual average flow Qm: 35 m^3/s Minimum average month flow rate/year 95% $Q_{95\%}$: 3.45 m^3/s Structure of the river bed: cobble, gravel and sand.
 Trotus - Vrinceni	 Trotus – downstream Adjud



Eight samplings of benthic macroinvertebrates have been performed in the five sampling points (Ghimes, Darmanesti, Tg Ocna, Vranceni and downstream Adjud) over the years 2003-2006 as follows:

In the period 2004-2006, there have been collected seven water samples as follows:

- four water samples in 2003 in each quarter of the year (March, May, August, October);
- one water sample in May 2004
- two water samples in 2005 (2nd and 3rd quarters, respectively in June and September);
- three water samples in the 2nd, 3rd and 4th quarters, but available data are from the 2nd quarter in May.

These water samples were taken by using a Surber sampler. These quantitative samples are of composed type (at least one sampler from all the types of water substrates; in mixing up all the sub-samples, there resulted a single assay-sample).

Four to eight samplers were examined, depending on substrate and the material was preserved with 4% formalin.

The material was partially selected on field surveys and totally analysed in the lab. After selection, it was preserved with 70% alcohol.

The identification of the material was performed in an alcohol medium with glicerin.

5. **The saprob index:** the Pattle Buck index is calculated using the list of saprob valencies according to Order 161/2006. The formula for calculus is:

$$S = \frac{\sum (s_i * h_i)}{\sum h}$$

where:
s = numerical value characteristic of its belonging to the saprob area
h = frequency of organisms
i = taxon
$\sum (s_i * h_i)$ sum of the products between the numerical value and the frequency for each taxon
$\sum h$ = sum of frequencies of identified taxons

All maps have been made with ARCMAP 9.0 (ESRI).

The inclusion within quality classes has been performed according to Order 161 / 2006:

Saprob index value	Saprob area	Impurification	Class	Ecological status
<1,5	Oligosaprobă	Absent	I	Very good
1,5 < 1,8	Oligo-beta-mezosaprobă	Low		
1,8 < 2,3	Beta-mezosaprobă	Moderate	II	Good
2,3 < 2,7	Beto-alfa mezosaprobă	Moderate to critical	III	Moderate
2,7 < 3,2	Alfa mezosaprobă	High	IV	Bad
3,2 < 3,5	Alfa polisaprobă	High to very high	V	Degraded
> 3,5	Polisaprobă	Very high		

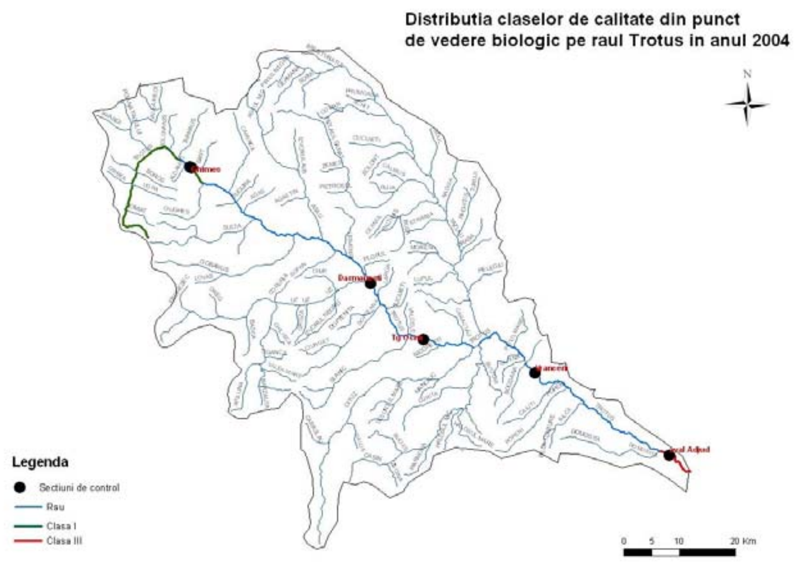
Results and discussions

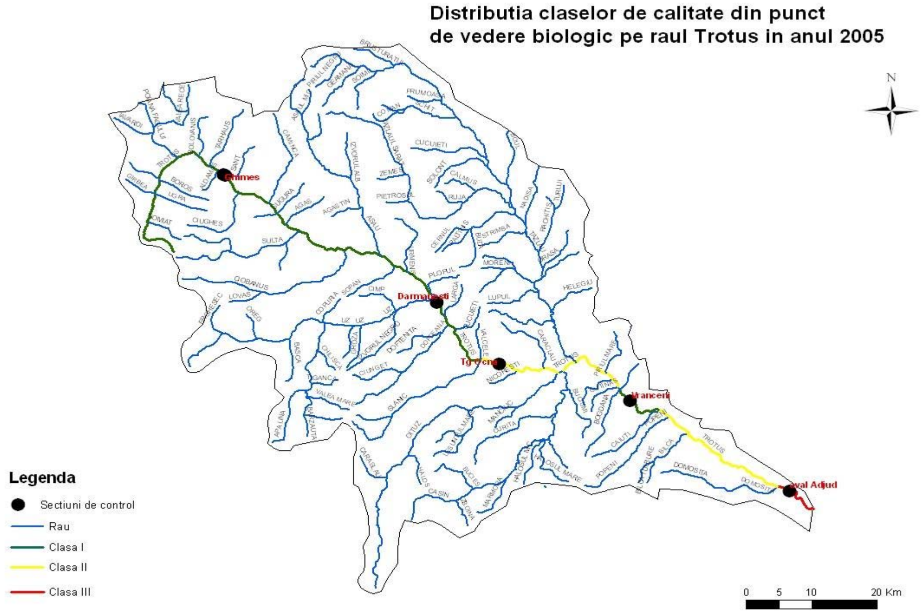
As a result of the lab analysis of the samples, there were obtained the following values as presented in these tables:

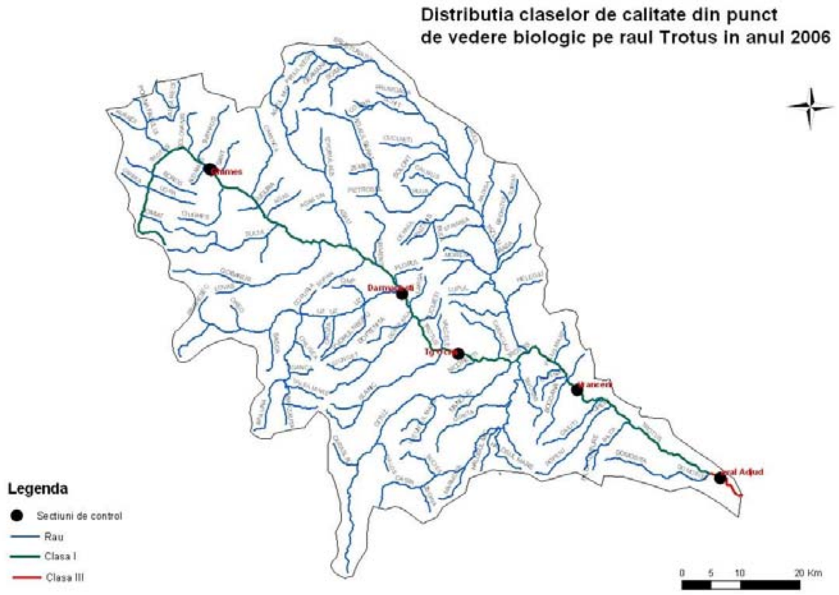
Sampling point	**2003**							
	1st quarter	**Class of quality**	**2nd quarter**	**Class of quality**	**3rd quarter**	**Class of quality**	**4th quarter**	**Class of quality**
Ghimes	1.9	II	1.56	I	1.39	I	1.28	I
Darmanesti	1.83	II	1.5	I	1.64	I	-	-
Tg Ocna	-	-	2.25	II	2.5	III	2	II
Vranceni	2.21	II	2.33	III	2.5	III	-	-
Av Adjud	2.7	III	2.5	III	2.5	III	2.5	III

Sampling point	2004		2005				2006	
	1st quarter	**Class of quality**	**2nd quarter**	**Class of quality**	**3rd quarter**	**Class of quality**	**2nd quarter**	**Class of quality**
Ghimes	1.47	I	1.68	I	1.7	I	1.76	I
Darmanesti	-	-	1.67	I	1.34	I	1.73	I
Tg Ocna	-	-	1.52	I	2.11	II	1.44	I
Vranceni	-	-	2.54	III	1.83	II	1.71	I
Av Adjud	2.41	III	2.48	III	2.36	III	2.57	III

Saprob index values registered in the sampling points of the Trotus river over 2003-2006







In the sections situated upstream the Trotus river, respectively Ghimes and Darmanesti, there is registered 1st class water quality (very good), in the sampling points of of Tg Ocna and Vranceni situated in the middle course of the river the values of the saprob index ranged in the 2nd and 3rd class, whereas in the downstream section (downstream Adjud), close to the mouth, the saprob index values were included in the thirrd class (satisfying). From the data presented on the maps, one can easily observe that, over the 2003-2006 period, the water quality has improved according to the saprob index all along the river course. This is primarily due to the closing down of some polluting economic agents and to the contribution of some administrative factors.

Conclusions

În 2003, the effects of the industrial activity were still felt in the Comanesti-Darmanesti-Onesti and the Adjud areas. Part of the industrial units along the Trotus Valley have reduced their activity, whereas others, such as the Darmanesti Refinery ceased all activity. The town wastewater treatment plants have entered programs of rehabilitation, retechnologization and optimization of the purifying processes; this contributed to the improvement in water quality along the Trotus river. However, because of insufficient funding, these municipal wastewater treatment plants have not been completely rehabilitated and the effect of sewage disposal is still felt.

In 2004-2005, there have been registered a series of historical rain torrents, which led to the over-flooding of the wastewater treatment plants and of the sewage systems in the towns of - Comăneşti, Tg Ocna and Oneşti. Under these circumstances, some of these plants were even clogged up (Comăneşti and Tg Ocna). At the present, all the operators in charge with the town plants (Tg Ocna, Oneşti, Adjud) have programs of gradual modernization and technologization or even building of new water plants which may treat municipal wastewaters and conform to the maximum admissable limits imposed by HG 352/2005 and HG 351/2005.

During the torrents from 2004-2005, there has been some accidental pollution due to the breaking or deterioration of the oil pipes from the Moineşti – Comăneşti – Oneşti area, pipes belonging to the Compet SA. In most cases, the pipe lines have been replaced and in the 2nd quarter of 2006, the frquency of the accidents has been reduced.

In 2006, as a result of the measures taken by the industrial units and the local councils from the Trotus area, as well as of the closing down of some economic agents with polluting potential (SC Carom SA) and thanks to the activity developed by the representatives of the Water Directorate, the pollution of the Trotus River has substantially decresed, a situation that is being confirmed by our graphs.

Over the period 2007-2015, all potentially-polluting units are under the obligation of self-monitoring their disposed wastewaters and of analisying wastewaters on production sections and purifying levels/treatment levels so that they can range within the maximum acceptable limits and stop the disposal of dangerous substances.

References

1. MALACEA I., 1969 – *Biologia apelor impurificate*. Editura Academiei Române.
2. *** 1984 – *Îndrumar metodologic pentru urmarirea evoluției calității apelor, prin intermediul analizelor biologice*. C.N.A Institutul de Cercetări şi Proiectări pentru Gospodarirea Apelor, Bucureşti.
3. *** *Directiva cadru a Apelor* – UE 60/2000
4. (*** Water Framework Directive – UE 60/2000).

COMPLEXUL MUZEAL DE ŞTIINȚELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 531 – 535

THE INTEGRATED MONITORING OF WATER RESOURCES IN TROTUS RIVER BASIN

DELIA GHEORGHE, FLORIAN PRISECARU*

ABSTRACT

GHEORGHE D., PRISECARU F., 2006 - The integrated monitoring of water resources in Trotus river basin. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 531-535.

The river basin waters are affected greatly by industrial and agricultural activities, as well as by waste water evacuations of the main urban localities. Trotus river basin has a modern system of water quality monitoring, which responds to the demands of the European legislation in this area. People are making continuous efforts to improve it, at the level of legislation, concept and instrumentation.

Key words: monitoring, water, Trotuş river.

Considering the fact that "***water is not a commercial product like any other, but a heritage to be kept, protected and treated accordingly",*** the European Union countries have proposed to elaborate a directive to establish the European strategy and policy regarding water.

The general purpose of the Water Framework Directive (WFD) 2000/60/EC is achieving a "***good status***" for all waters in Europe. At the same time, this means achieving a good ecological and chemical status for all surface and ground waters.

The monitoring system provided by the WFD and the other European Directives is represented by 6 subsystems, as follows:

- Subsystem for rivers;
- Subsystem for lakes;
- Subsystem for transitional waters;
- Subsystem for coastal waters;
- Subsystem for groundwater;
- Subsystem for waste waters.

The new system of water monitoring includes the subsystem for protected areas related to water, which contains:

- protection areas for drinking water abstractions;
- protection areas for aquatic species of economical importance;
- protection areas for habitats and species where water is an important element;
- areas vulnerable to nitrates;
- natural bathing areas.

According to the demands of WFD, the national monitoring system includes three types of monitoring:

- surveillance monitoring;
- operational monitoring;.
- investigation monitoring.

The surveillance monitoring – has a role in evaluating the water status of each river basin or sub-basin. The surveillance monitoring supplies information in order to validate the impact evaluation procedure, to efficiently design future monitoring programmes and to evaluate the long term variation tendency of water resources.

The operational monitoring must be done for all water bodies which, based either on the impact according to Annex II of WFD, or on the surveillance monitoring, have been identified as having the risk of not complying to the environmental objectives. Its purpose is to establish the status of the aquatic ecosystems which present the risk of not complying to the environmental objectives. This type of monitoring must be done for all water bodies subject to priority substances discharge.

The investigation monitoring – is used to certify the causes for which a water body cannot achieve the environmental objectives, and to identify the causes for exceeding the quality standard limits.

According to the demands of WFD and of the other directives regarding water, the subjects of investigation are:

* Siret Water Directorate, 1 Cuza Voda Street, Bacău, Romania

- water;
- sediments;
- biota.

The new monitoring network includes the following monitoring programmes:

• **The surveillance monitoring programme (S)** has the purpose of evaluating the global water status in each river basin or sub-basin.

• **The operational monitoring programme (O)** must be realised for all the water bodies, which, due to pressures, impact evaluation and surveillance monitoring, are identified as having the risk of not complying with the environmental objectives.

• **The investigation monitoring (I)** is necessary in order to identify the causes that determine the limit exceedings of quality standards and of other water management regulations.

• **The reference programme (R)** is established for those natural or quasi-natural sections either without human impact or with human influences. **The "best section available" (BSA)** will be used for each water course subject to human activity and for which no section of reference was found

• **The intercalibration programme (IC)** refers to the sections included in the European intercalibration exercise.

• **The potabilisation programme (P)** refers to surface water abstraction designated for potabilisation

• **Vulnerable areas monitoring programme (VA)** refers to the monitoring sections from the perimeters defined as areas vulnerable to nitrates pollution.

• **Ihtyofauna monitoring programme (IH)** refers to the identified salmonicole and ciprinicol areas.

• **Habitat and species protection programme (HS)** will be applied in protected areas, to monitor the parameters of the water medium characteristic to the protected fauna and/or fauna.

• **International conventions programme (IC)** will monitor the sections and parameters mentioned in the international conventions and agreements.

• **CAPM programme** has as purpose the knowledge of the impact the hydro-morphologic alterations has on water.

1.1. The river subsystem

In Trotus river basin there have been established for this subsystem 20 monitoring sections, as shown in figure 1.

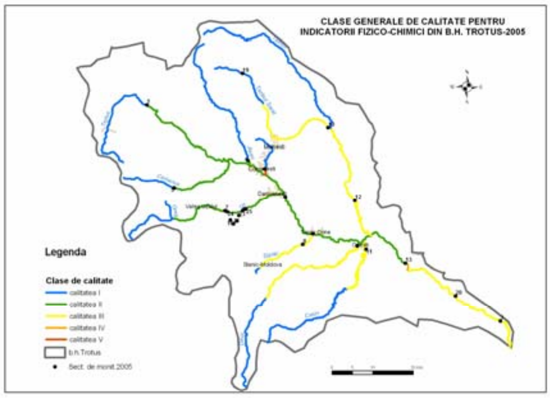


Fig.1 - Monitoring network for river subsystem and classes of quality

The types of river monitoring programmes are: S-surveillance, O-operational, I-investigation, R-reference, BSA-best section available, IC-intercalibration, P-potabilisation, VA-areas vulnerable to pollution with nitrates from agricultural sources, IH-ihtyofauna, HS-habitats and species, KIHA- knowledge of the impact of hydro-morphologic alterations.

The 12 programmes apply as follows:

Tab. 1 - Types of programmes and monitoring sections in Trotus river basin

Nr.	Types of monitoring programmes	Symbol	Total number of monitoring sections	RIVERS	LAKES	GROUN WATERS Quality Quantity	WASTE WATERS
1	Surveillance	S	75	20	5	31	19
2	Operational	O	46	8	0	19	19
3	Investigation	I	-	-	-	-	-
4	Potabilisation	P	16	8	5	3	0
5	Reference	R	2	2	0	0	
6	Ihtyofauna	IH	25	20	5		
7	Vulnerable Areas	VA	14	4	0	10	
8	Protection of Habitats and Species	HS	-		-	-	-
9	"Best Section Available"	BSA	1	1			
10	Intercalibration	Ic	-	-	-		
11	International conventions	IC	-	-	-		
12	Knowledge of the impact of hydro-morphologic alterations	KIHA	1	1			

Regarding quality, the indicators to be monitored are physic-chemical, bacteriological, biologic and eco-toxicological for every element: water, biota, sediments.

1.2 The lake subsystem

The subsystem for lakes includes a number of 5 sections on Poiana Uzului reservoir.

The sections and sampling profiles for reservoirs are: end of lake (surface profile), middle of lake (profiles: surface, photic area and photic area limit), dam (profiles: surface, photic area and photic area limit), right bank, and, for those that have drinking water abstraction, inlet sampling.

The monitoring programmes for Poiana Uzului reservoir are: S, P, IH.

The monitoring elements and parameters (regarding the risk categories) for each investigation element: water, sediments, and biota.

1.3 Subsystem for groundwater

In order to track the variation of the drilling levels in Trotus river basin, it has been proposed the monitoring of 33 drills in the national observation network, of which 18 drills are proposed to be monitored in order to determine the quality of phreatic groundwater.

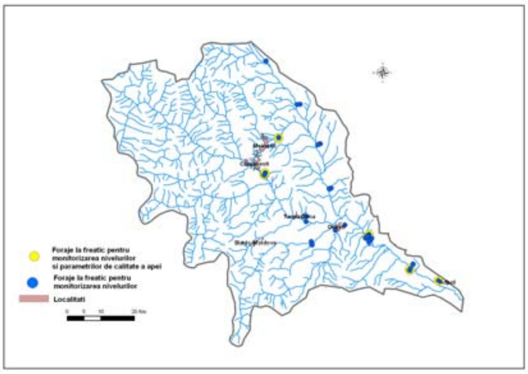


Fig. 2 - The hydro-geologic drills network in Trotus river basin.

The types of monitoring programmes for the groundwater subsystem in Trotus river basin are: S – surveillance, O – operational, P – potabilisation.

The element of investigation is water. The monitoring frequency for the drills in the state hydrological network and for the drills that monitor pollution on industrial platforms will be biannual. In case of drinking water abstraction, the frequency will be 4 times/year.

The monitoring elements are: quantity and quality (physic-chemical and bacteriological).

Physic-chemical Indicators:

- G - general (conductivity/fix residuum, pH, alkalinities);
- SO - organic substances (dissolved oxygen, CCO-Mn);
- N-nutrients (nitrites, nitrates, ammonia, orthophosphate);
- SP-MG- heavy metals from the list of priority/hazardous substances HG 351/2005 (Cd, Pb, Hg, Ni);
- SP-MO - organic micro-pollutants from the list of priority/hazardous substances HG 351/2005
- AP–other parameters selected based on groundwater use, as well on identified human pressures (due to punctiform sources of pollution, diffuse sources and land use).
- Bacteriological indicators: CT– total coliforms, CF– faecal coliforms, SF– faecal streptococci.

The microbiological parameters will be executed in the sections intended for drinking water abstraction (Directive 75/440/EEC – HG 100/2002).

In case of drillings that monitor pollution on industrial platforms, it will be analysed the physic-chemical parameters specific to the industrial activity performed by the respective unit.

1.4 Subsystem for protected areas

1.4.1 Protection areas for water abstraction intended for drinking

In order to monitor the sections related to the water abstractions intended for drinking, it has been designed a special program **P**. Each monitoring section/drill placed in such protection areas will be provided with this monitoring programme, which will be integrated to the other monitoring programmes representative for the analysed section/drill (S, O, I, P, R, IH, VA, HS, BSA, Ic, IC, KIHA).

In Trotus river basin there have been designated 5 protected areas for surface water abstraction and 8 for groundwater abstraction.

For the drinking water programme (P) there have not been established drills to be monitored by the economic agents that exploit them.

The monitoring elements are: quantity (H – level and Q – flow) and quality (physic-chemical and bacteriological).

For the sections related to the water abstractions intended for drinking (monitoring programme P), there will be monitored all parameters in HG 100/2002 (NTPA 013/2002) and the priority/hazardous substances, the frequency being related to the served community.

The monitoring elements and parameters specific for surface waters (according to HG 100/2002) are:

Physic-chemical Indicators:

- G - general (temperature, conductivity / fix residuum, pH, alkalinity, sediments, colour);

- SO – SO - organic substances (dissolved oxygen, CCO-Mn, CCO-Cr, CBO_5, COT);
- N - nutrients (nitrites, nitrates, ammonia, orthophosphate);
- SP-MG – SP-MG- heavy metals from the list of priority/hazardous substances HG 351/2005 (Cd, Pb, Hg, Ni);
- SP-MO – organic micro-pollutants: total pesticides (parathion, HCH, dieldrin), PAH
- AP – hazardous substances from list I and II of HG 351/2005;

  Bacteriological indicators: CT- total coliforms, CF– faecal coliforms, SF– faecal streptococci.

For the groundwater abstraction sections all parameters will be monitored, according to Drinking Water Law 458/2002, modified and completed by law 311/2004, as well as for the drills in the national hydrologic network, considering the fact that for drinking water drills it will be realised bacteriological determinations. The monitoring frequency will be 4 times/year.

1.4.2 Protection areas for aquatic species of economic importance

To monitor surface water in the areas to protect aquatic species economically important, it was established a special programme **IH**. Each monitoring section/drill placed in such protection areas will be provided with this monitoring programme, which will be integrated to the other monitoring programmes representative for the analysed section/drill (S, O, I, P, R, IH, VA, HS, BSA, Ic, IC, KIHA).

So far, for the inner water courses, the aquatic species economically important have not been taken into consideration.

In perspective, the water courses where the common trout (Salmo trutta fario) and the grayling (Thymallus thymallus) live can be included in the protected areas category, regarding their importance in fishing and tourism.

In Trotus river basin, the designation of the protection areas for economically important aquatic species was made on the inner water courses, where the following species live:

- Salmo trutta fario,
- Thymallus thymallus
- Hucho hucho

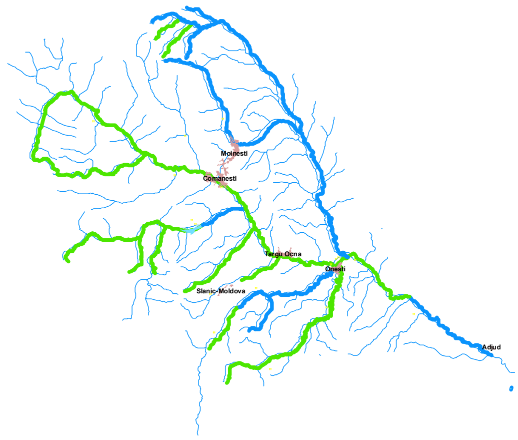


Fig.3 - Salmonicole and ciprinicole areas

1.4.3. Areas designated for the protection of habitats and species where water is an important factor

The areas for the protection of habitats and species where improving water status is an important factor were proposed based on Directive 92/43/EEC, which promotes the protection of the EU natural patrimony, transposed in the Romanian legislation through law 462/2001 and Directive 79/409/EEC, related to bird protection, transposed in the Romanian legislation through law 13/1993.

In this category of protected areas there were included the areas mentioned in law 5/2000 and HG 2151/2004, regarding water.

In Trotus river basin there were identified 2 protected areas: Bucias area and Bolatau natural lake.

1.4.4. Areas vulnerable to nitrates

These areas include areas vulnerable according to Directive 91/676/EEC, HG 964/2000 respectively, regarding the protection of waters against nitrates from agricultural sources and sensitive areas defined according to Directive 91/271/EEC, HG 351 /2005 respectively, regarding limits of waste water discharge.

Regarding vulnerable areas delimitation, first it was analysed the natural vulnerability, that is the pedo-hydro-climatic characteristics of the area from the perspective of transmitting nitrates to water courses. The area was considered vulnerable if the nitrates coming from agricultural sources added to the natral vulnerability.

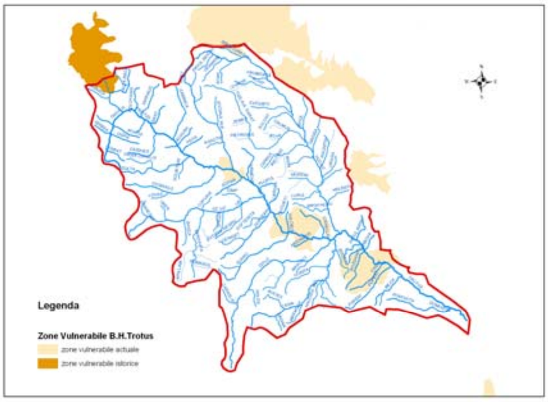


Fig. 4 - Areas vulnerable to nitrates pollution in Trotus river basin

The actual sources of nitrates in the localities from Trotus river basin come mainly from the functional zoo-technical complexes, and from animal rising in individual farms. The dysfunctional zoo-technical complexes, or those in which the number of animals decreased have contributed as historical sources of nitrates to groundwater pollution. The next table shows the list of localities vulnerable to nitrates pollution.

Tab. 2 - The list of localities vulnerable to nitrates pollution in Trotus river basin.

Nr. crt	Comuna	Judet	suprafata (ha)		sursa no_3 la nivelul comunei	
			agricol	arabil	surse actuale	surse istorice
1	Caiuti	Bacau	3412	1893	*	
2	Ştefan cel Mare	Bacau	5253	3430	*	
3	Târgu Ocna	Bacau	2690	372	*	

In the areas declared vulnerable to nitrates pollution, the farm management must be done according to the Code of Good Practices in Agriculture.

Also, it will be done the monitoring of conformity for soil and water courses, according to the present legislation.

In Trotus river basin 4 river sections and 10 drills are monitored during vulnerable areas programme (see the next table).

1.4.5. Natural areas designated for bathing

The natural bathing areas are presented in Directive 76/160/EEC, transposed into Romanian legislation by HG 459/2002.

So far, there have been no such areas designated in Trotus river basin.

1.5 Subsystem for waste waters

Waste waters are analysed during the monitoring system, the results being at the same time an auto-monitoring control done by users during the activity of monitoring the achievement of conditions provided in the "subscription".

In Trotus river basin there were established for monitoring 19 sections on users' evacuations. (fig. 5)

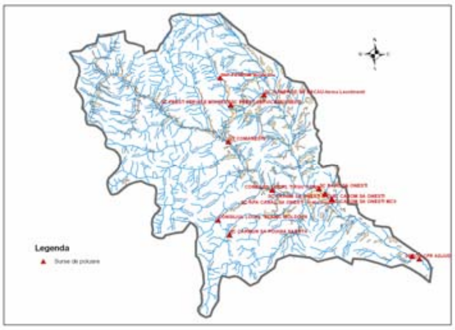


Fig. 5 - Map of pollution drills in Trotus river basin

The monitored elements are both of quality and of quantity. These were established through the water management agreements, according to the type and characteristics of the water service, according to HG 352/2005.

In order to determine the relevant pollutants there will be continued the screening analyses for all the economic agents that spill priority/hazardous substances. If analyses reveal such substances in water, there will start monitoring the relevant pollutants in the waste waters evacuated by users too.

Conclusions

The river basin waters are affected greatly by industrial and agricultural activities, as well as by waste water evacuations of the main urban localities.

Human activities developing, the aquatic media continuously confront with the complex problems of natural characteristics degradation, fact which requires the adoption of urgent measures of knowledge, conservation and integrated management of water.

Knowing and evaluating the status of water bodies with all identified pressures supposes the existence of a performing system of water quality monitoring. The main purpose of WFD 60/2000/EEC is to achieve a good status for surface and groundwater. This means at the same time a good ecological and chemical status.

Nowadays, Trotus river basin has a modern system of water quality monitoring, which responds to the demands of the European legislation in this area. People are making continuous efforts to improve it, at the level of legislation, concept and instrumentation.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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MONITORING PARAMETERS RELATED TO THE WATER IN LAKE OCHIUL MARE OF THE NATURAL RESERVATION "PETA RIVULET", BIHOR COUNTY

VASILE – MAXIM DANCIU *

ABSTRACT

DANCIU V.M., 2006 - Monitoring parameters related to the water in Lake Ochiul Mare of the Natural Reservation "Peta rivulet", Bihor county. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 536-543.

The paper focuses on the observation of several parameters related to thermal water temperature at Ochiul Mare on the one hand, on the other hand, to elements of its chemistry within the natural reservation "Peta Rivulet", Bihor county. The importance of this area of the reservation consists of its peculiarities, as it hosts two species considered to be relict, and an endemic one; the thermal nature of this ecosystem is provided by the central spring at Ochiul Mare whose flow is estimated to decrease, endangering the biodiversity of the zone. Monitoring specific parameters aims at foregrounding environmental elements that, together with the flora and the fauna of the lake, can bring the necessary information regarding strategies of preservation that should be employed in order to maintain the specificity of this natural reservation.

Key words: thermal water, water lily, water ecosystem

Introduction

The natural reservation "Peta Rivulet" is situated in 1st May Spas (the former Episcopalian Spas nearby Oradea) and stands for the only thermal water ecosystem in our country. In the warm waters of the Peta rivulet there lives the thermal water lily (*Nymphaeae lotus* L. var *thermalis* (D.C.) Tuzs.) together with a small thermal snail (*Melanopsis parreyssi* Muhlfeld), both species being considered tertiary relics, as well as with an endemic species of fish, "Racovita's red-eye" (*Scardinius erythrophtalmus racovitzai* Muller). The reservation is divided into three zones: - zone I. lying between the Waved Swimming-pool and the Forested area down to the Gypsies' footbridge (here is the historical spring of the reservation, Ochiul Tiganului, completely clogged today); - zone II., spreading from the Gypsies' footbridge to the Rontau footbridge, known as Ochiul Mare, where the main spring is to be found, with the highest flow; - and zone III., anthropically influenced by previous hydro-technical works, lies between the Rontau footbridge and the Venus pool. The study focuses only on a part of zone II, that is, the pond from Ochiul Mare, an area with more prominent natural representative. It is worth mentioning that the reservation is in the custody of the Cris Counties Museum, according to the agreement no. 3008 / 20.04.2004.

Material and method

In some resources, Ochiul Mare denotes the pond-like area lying between the Gypsies' footbridge and the Rontau trough it is sub-called either Petea Lake (Berindei et al.,1970), or Ochiul Mare pond (Soldea, 2003), and it is was morphometrically measured in 1970 as follows: its total surface is of 4188.4 square meters, 3327.6 sq. m. being the water table the water volume was of 1365.3 cube meters – length of 106 m, width of 60 m, and average depth of the water table of 0.40 m. The measurements related to the flow of the central spring of Ochiul Mare pointed to values ranging from 150 to 300 liters / sec. (Paal, 1975). The present objectives target to monitoring several parameters regarding water temperature and water chemistry in order to create a data basis for zone II of the reservation, as this is the most prominently representative place of this thermal water biota. The temperature measurements were carried out with a lab thermometer, and chemical tests of the water were made in the Laboratory of Cris Rivers Department of Oradea; this interpretation method is a comparative one referring to norms regarding

* Cris Counties Museum, Oradea

target objectives for surface water quality classification, concerning water chemistry (ord. MAPM no. 1146 / 2003). When it is about temperature, one considers the heat source (geothermal deposit) coming from the main stream, respectively three spots carefully selected as distanced from it, that is , a closer one (the "Mulberry" spot), a marginal one (the "Pocket" spot) and the footbridge at the entrance of the upstream valleys (Glighii and Betfia valleys).

Results

Temperature recording was performed at the lake side 10-20 cm deep, in three spots ("mulberry", "pocket", "footbridge"), considered as representative due to their position versus the main spring, more than 3 m deep, with a water temperature reaching 30-32 °C. It has been noticed that after 1999 when these three spots selected as reference – points (Danciu, 2004, 2005), the temperature oscillations range from 17.6 to 30.3 ºC in cold seasons (October-March), respectively from 28.2 to 31.8 °C in warm seasons (April-September) at the "mulberry" spot. At the "pocket" spot, temperature oscillations vary from 12.5 to 29 ºC in cold periods, and from 20.2 to 29 °C in warm periods, whereas at the "footbridge" spot the temperature oscillations range from 9 to 27 ºC in cold months, respectively from 18 to 27 in warm months, as shown in diagrams no.2, 3, and 4. The flow level of the main spring (diagram 1.) close to a critical moment (10 % as compared to the first recording in 1860), makes us increase our awareness about both biodiversity and the management of thermal deposit, the later being the central objective that shapes the specificity of this biota.

Elements related to water chemistry refer to pH, oxygen and nutrient conditions, these being important referent points in assessing there water quality, as well as the development of species of water flora and fauna specific to this biota, and they also represent essential items in evaluating the eutrophication of this lake. The results in compared to standard values regarding stream water quality are as follows:

- The pH values recorded in the observation period oscillate between 6.9 and 8.3, as shown in Figure no. 5, compared to the standard values ranging from 6.5 to 8.5.
- The chemical oxygen consumption points to values oscillating between 0.5 mg / l and 9.2 mg / l as shown in Figure 6, whereas the standard values range from 5 to 10 mg / l.
- When it is about biological oxygen consumption, the determined values oscillate between 0.5 mg / l and 12.5 mg / l, as shown in Figure no.7, the standard values ranging to from 3 to 5 mg / l (except for two situation, one in November 2003 and one in August 2005 when the determined values an identical to the standard ones)
- Regarding the nutrient conditions, the determined values, shown in Figure no.8, range within standard intervals, except for situation of 2004 in case of nitrates and nitrites (the norms for ammonium stipulate an interval between 0.2 – 0.3 mg / l, in case of nitrites of 1 – 3 mg / l in case of nitrates, and of 0.05 – 0.1 mg / l in case of phosphates).

Conclusions

We can conclude that there is a decrease in the geothermal spring flow at Ochiul Mare, influencing the water temperature. Out of the three selected location, the warmest water it as the "mulberry" spot though slightly colder (especially in February and March) than that recorded at Ochiul Mare in 1938-39 (Olteanu Cosma, 1977) and in 1976-77 (Paina, 1978), when its values in cold seasons ranged from 25 to 30 ºC and warm seasons, from 29 to 32 in the former recording, and in the latter, in 1976, the water temperature oscillated between 20.5 and 28.8 °C in cold seasons and 28.6 and 30.7 ºC in warm seasons. Now at the "mulberry" spot there are values between 17.6 – 30.3 ºC in cold seasons, respectively, 28.2 – 31.8 °C in warm seasons. At the "pocket" spot, the water temperature in cold seasons reaches 12.5 °C (February, 2005), whereas in warm seasons it does not exceed 28.8 ºC (June,2004), finally, at the "footbridge" spot there are 6.5 °C in winters (February, 2004) and 27 ºC in summers. When we refer to temperatures, the most important element it the level of the central spring flow which should be, besides its natural potential, connected to the management strategies of the geothermal deposit in Felix – 1 Mai.

When it is about the water chemistry at Ochiul Mare we observe that pH values answer quality standards. The observation of oxygen conditions points to items partially answering the quality standards for protecting water ecosystems. The determined values of biochemical oxygen consumption show that bath organic and inorganic substances are partially biodegradable, whereas the recorded nutrients values are characteristic for the process of eutrophication.

Rezumat

În lucrare s-a avut în vedere urmărirea unor parametri legați de temperatura apei termale de la Ochiul Mare şi de unele elemente ale chimismului ei, din cadrul rezervației naturale „Pârâul Peța", județul Bihor. Importanța acestei zone din cadrul rezervației, constă tocmai prin reprezentativitatea sa, ea adăpostind două specii reliucte şi una endemică, caracterul termal al acestui ecosistem fiind dat de izvorul central de la Ochiul Mare, şi al cărui debit

estimat este în scădere, punând în pericol biodiversitatea specifică zonei. Acțiunea de monitorizare are ca scop urmărirea unor parametri de mediu, care împreună cu flora şi fauna din lac, să ne dea informațiile necesare pentru măsurile conservative ce trebuie luate în vederea menținerii specificului acestei rezervații naturale.

References

1. BERINDEI I. şi colab. 1970 - *Lacul Pețea.* Lucrările Colocviului Național de Limnologie fizică – Institutul de Geografie al Academiei RSR, Bucureşti, 59-66
2. DANCIU V. M., 2004 - *Aspecte privind starea calității apei la rezervația naturală Pârâul Peța de la Băile 1 Mai.* Nymphaea,. XXXI, Oradea, 35-53.
3. DANCIU V.M. 2005 - *Considerații asupra unor factori de mediu cu privire la rezervația naturală Pârâul Peța de la Băile 1 Ma.* Nymphaea, XXXII, Oradea, 115-147.
4. OLTEANU COSMA C., 1977 - *Biologia nufărului termal Nymphaea lotus L. var. thermalis (D.C.) Tuzs. De la Băile 1 Mai – Oradea.* Nymphaea, V., Oradea, 365-380.
5. PAAL G., 1975 - *Contribuții la hidrologia zăcământului de ape termale din zona Oradea-Felix.* Nymphaea, III., Oradea, 11.
6. PAINA I. M., 1978 - *Câteva considerații asupra factorilor abiotici în rezervația naturală de la Băile 1 Mai (-temperatura-).* Nymphaea, VI, Oradea, 645-672.
7. ŞOLDEA V., 2003 - *Peța şi nufărul termal.* Editura Universității din Oradea.

Fig.1

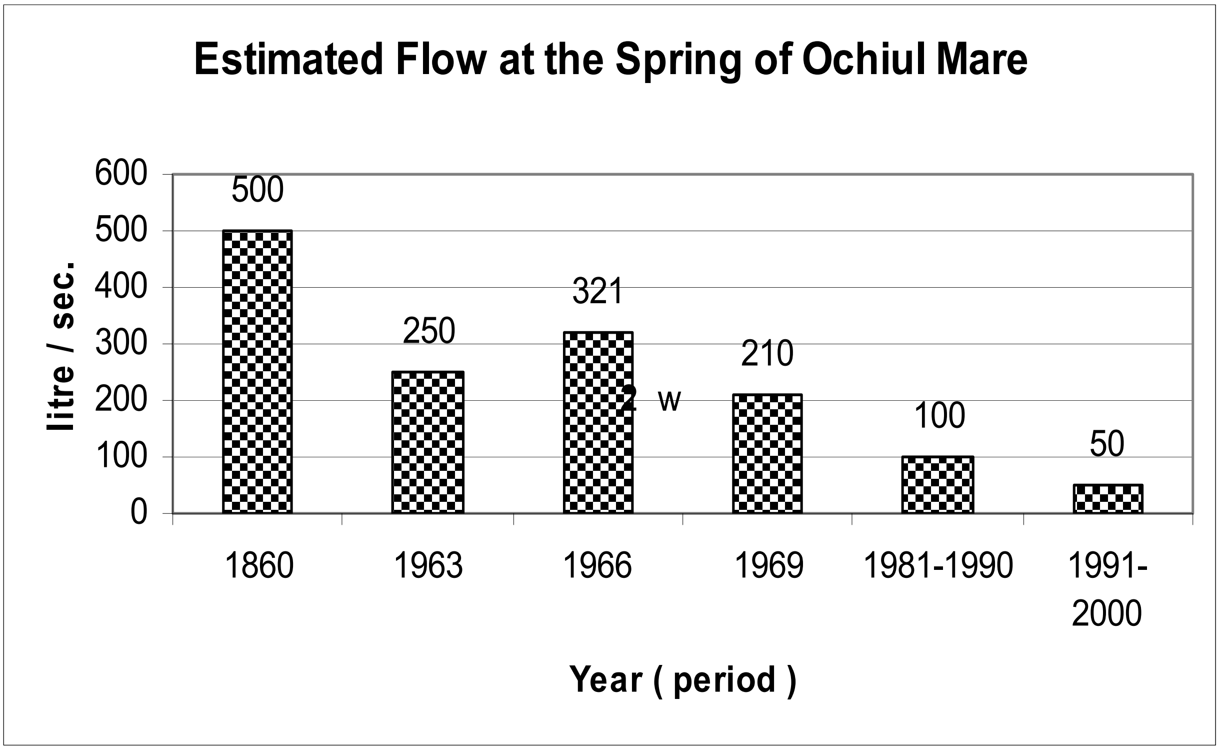
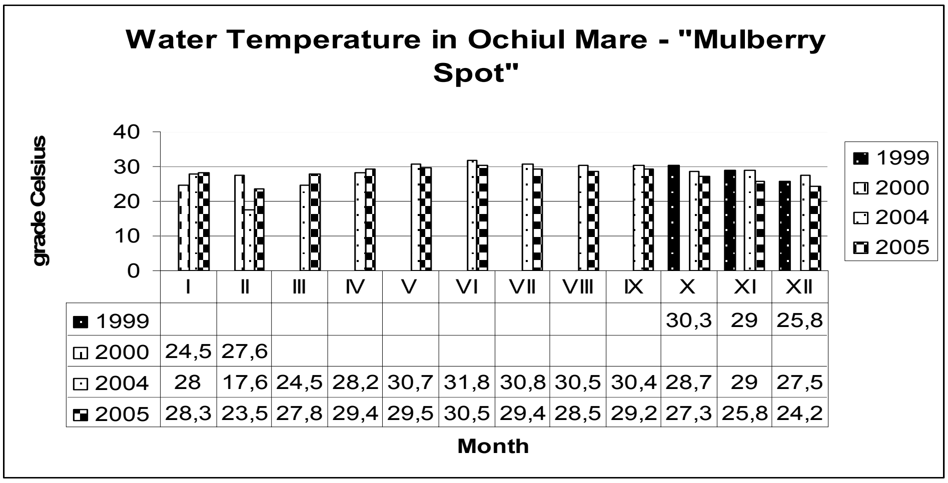
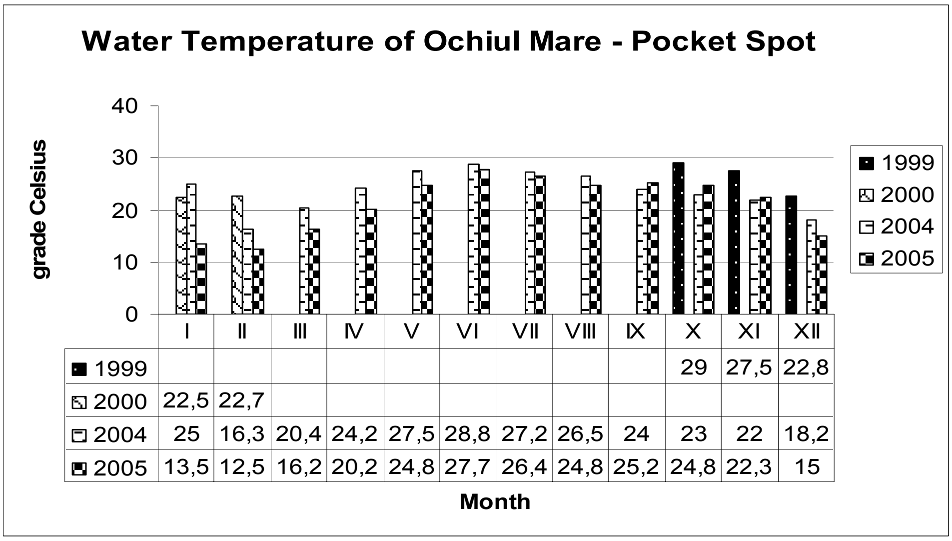


Fig. 2



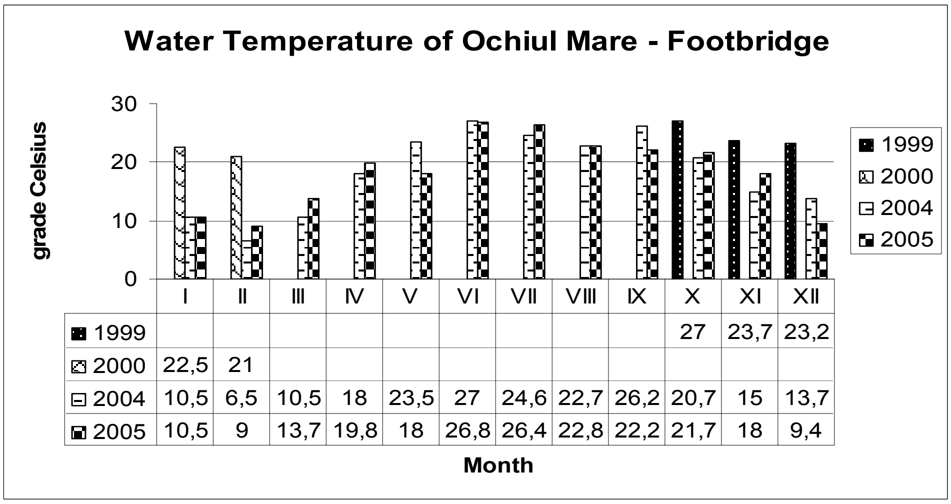
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1999										30,3	29	25,8
2000	24,5	27,6										
2004	28	17,6	24,5	28,2	30,7	31,8	30,8	30,5	30,4	28,7	29	27,5
2005	28,3	23,5	27,8	29,4	29,5	30,5	29,4	28,5	29,2	27,3	25,8	24,2

Fig. 3



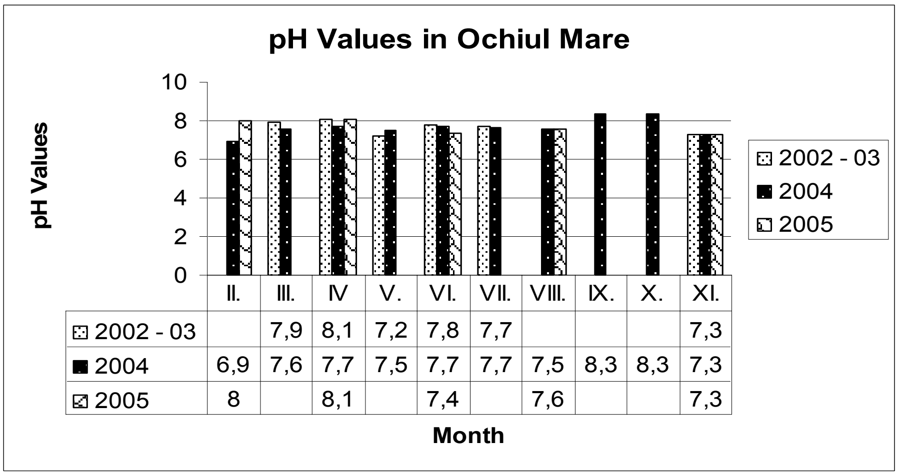
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1999										29	27,5	22,8
2000	22,5	22,7										
2004	25	16,3	20,4	24,2	27,5	28,8	27,2	26,5	24	23	22	18,2
2005	13,5	12,5	16,2	20,2	24,8	27,7	26,4	24,8	25,2	24,8	22,3	15

Fig. 4



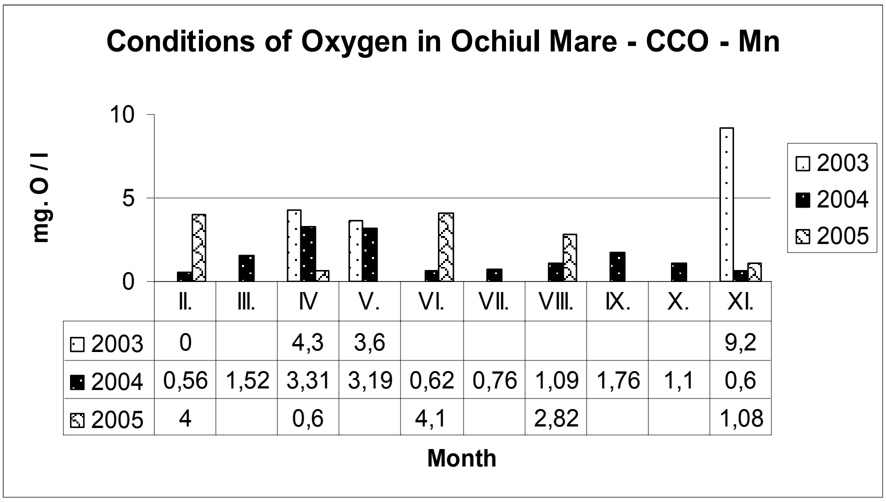
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1999										27	23,7	23,2
2000	22,5	21										
2004	10,5	6,5	10,5	18	23,5	27	24,6	22,7	26,2	20,7	15	13,7
2005	10,5	9	13,7	19,8	18	26,8	26,4	22,8	22,2	21,7	18	9,4

Fig. 5



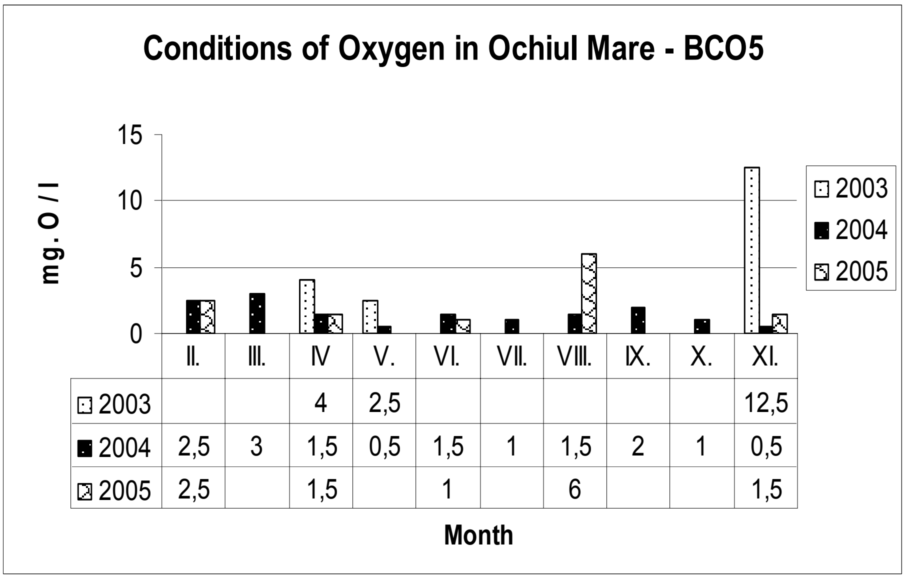
	II.	III.	IV	V.	VI.	VII.	VIII.	IX.	X.	XI.
2002 - 03		7,9	8,1	7,2	7,8	7,7				7,3
2004	6,9	7,6	7,7	7,5	7,7	7,7	7,5	8,3	8,3	7,3
2005	8		8,1		7,4		7,6			7,3

Fig. 6



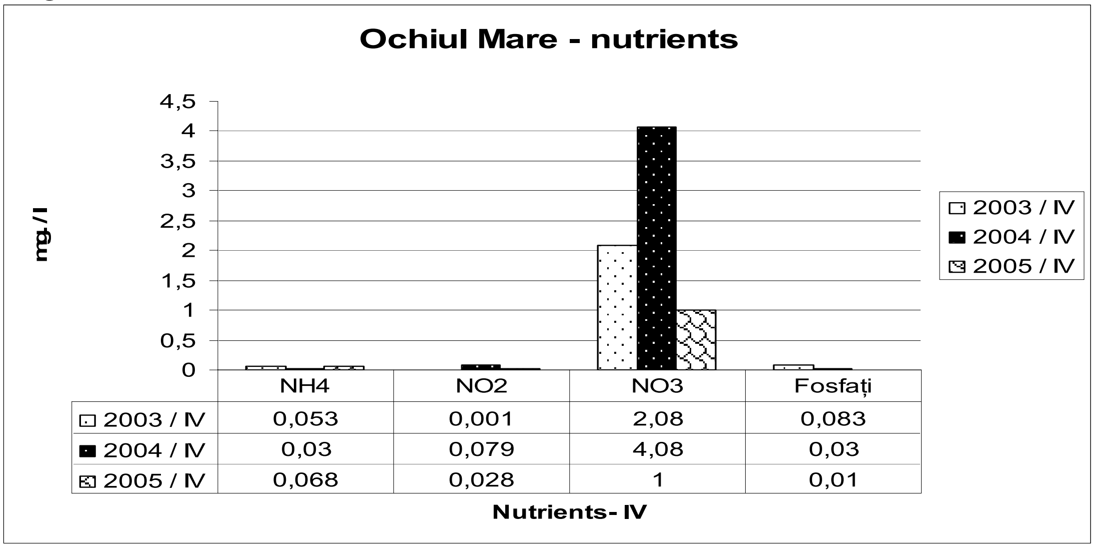
	II.	III.	IV	V.	VI.	VII.	VIII.	IX.	X.	XI.
2003	0		4,3	3,6						9,2
2004	0,56	1,52	3,31	3,19	0,62	0,76	1,09	1,76	1,1	0,6
2005	4		0,6		4,1		2,82			1,08

Fig. 7



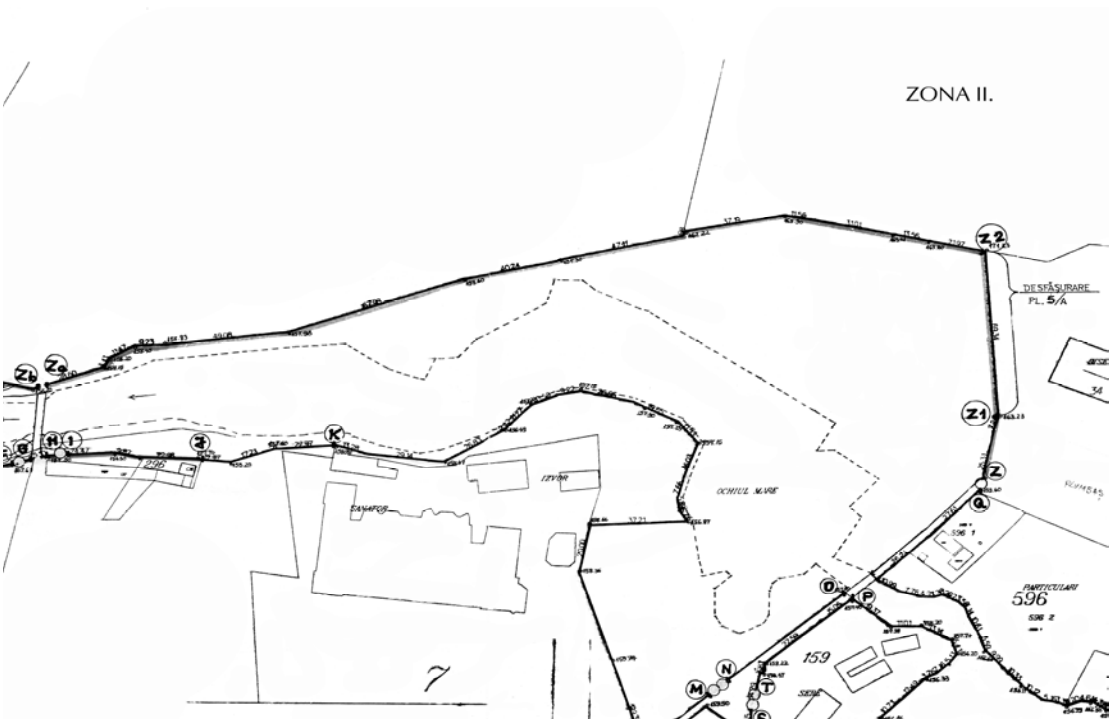
	II.	III.	IV	V.	VI.	VII.	VIII.	IX.	X.	XI.
2003			4	2,5						12,5
2004	2,5	3	1,5	0,5	1,5	1	1,5	2	1	0,5
2005	2,5		1,5		1		6			1,5

Fig. 8



	NH4	NO2	NO3	Fosfați
2003 / IV	0,053	0,001	2,08	0,083
2004 / IV	0,03	0,079	4,08	0,03
2005 / IV	0,068	0,028	1	0,01

Fig. 9
Perimeter of Zone II of „Peta Rivulet" Reservation – the Ochiul Mare Lake



Ochiul Mare – the “Mulberry Spot”

Ochiul Mare – the “Pocket Spot”

Ochiul Mare – general view (from “the pocket” towards the footbridge)

Ochiul Mare – at the footbridge (water lilies on the left shore)

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 544 – 546

PART IV – RESTAURATION, MUSEOLOGY, ANNIVERSARIES

FACTORS INVOLVED IN THE BIODETERIORATION OF THE ICONOSTASIS OF THE "SAINT NICHOLAS" CHURCH OF POIENI, DISTRICT OF IAŞI

GEANINA BRATU, MARIANA MUSTAŢĂ*

ABSTRACT

BRATU G., MUSTAŢĂ M., 2006- Factors involved in the biodeterioration of the iconostasis of the "Saint Nicholas" Church of Poieni, District of Iaşi. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 544-546.

Among the factors involved in the deterioration of the patrimonial objects, most aggressive are the biotic ones. The present study analyzes the main biological factors causig deterioration of the iconostasis of the Saint Nicholas church in the village of Poieni, the distict of Iaşi.

Keywords: biodeterioration, biological factors, insects, microfungi.

Introduction

Biodeterioration of the patrimonial objects made of structurally different materials assumes the activity of a whole trophic chain, in which some organisms open the way to others. The relation created among various biological species is a close, symbiotic one, so that each of the species involved can live, grow and reproduce exclusively in the presence of the other. The activity of certain biodeteriorating factors would be much more difficult, or even impossible, without a "preparation" of the substrate from the part of microorganisms. Thus, the xylophagous insects cannot feed themselves in the absence of the phlagelate fauna from their digestive tube.

For better understanding the mechanism of biodeterioration, full knowledge on the abiotic factors (temperature, relative humidity, light, pH, aeration) that may favourize, precipitate or restrict the action of the biodeterogeneos factors is absolutely necessary, if considering its special importance in the prevention and control of deterioration produced by micro and macroscopic organisms.

Within such a complex, materials' susceptibility to biodeterioration plays a special part and may explain the presence of a certain biological agent on a substrate or equally, the absence of another one.

The iconostasis (deriving from the Greek term. "iconostasis", i.e. upholder of icons) is the wall separating the altar from the nave on which the icons are arranged on several registers; it may be made of quite diverse materials, which increases its the susceptibility to biodeterioration.

Although the iconostasis seems to be preponderently made of materials resisting any biological attack, the risk of its deterioration is related to the most vulnerable material, through which the biodeterogeneous factors open their way to the other constituents.

The higher is the ratio in which the most vulnerable material is present, the higher will be its susceptibility to biodeterioration. Simple traces of organic matter open the way to the installation of a trophic chain which, finally, will succeed in decomposing the substrate. Dust and filth also increase the susceptibility to biodeterioration by the possible nutrition source they represent for the first "colonizers" of the object, as well as by its hygroscopicity which grants an optimum humidity for their subsequent development.

The iconostasis here under study belongs to the "Saint Nicholas" church of Poieni, district of Iaşi, (founded by Alexandru Balş, the great treasurer of Prince Mihail Sturza, between 1839 and 1842) created in the XIX th century, the oil painting of the iconostasis shows a neo-classical style, with baroque influences. It includes 48 icons, arranged on several registers,

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alternating with wood sculptured, polished floral decorations.

The painting has been applied on a limetree support covered with a very thin ground preparation including – among others – chalk powder, glue and flax oil. Several signs of degradation – provoked by a cummulated action of the biological, chemical and physico – mechanical factors - have been observed both on the woody support and to the painting layer.

Materials and method

Photographic documents and mappings have been made for a comparative analysis of the attacked areas, the conservation condition of the whole assembly being thus established. For the identification of the biological agents taking an active part in degradation, biological material from different elements of the iconostasis (adults, larval exuviae) has been collected, followed by insemination - through a non-distructive taking over, by means of a special materials - on culture media, in Petri plates. Examination of the microscopic preparations was made by optical microscopy.

Results and discussion

The support shows an intense xylophagous attack, as evidenced by hatching orifices and galleries of various sizes, present on the whole surface of the iconostasis: at its bottom, on the pillars, cornices, frames, as well as on the icons- especially in their inferior part. The attack is active, as indicated by the fine sawdust flowing from the orifices (verso); its intensity apears more prononced on half of the iconostasis, on its southern side, over its whole height, from the bottom to the top (icons, friezes, bearing, systems), as a result of the higher humidity of his area. The rusty color of the sawdust indicates the presence of other biological agents contributing to degradation -i.e., the fungi -, the action of which had "prepared" the support for the xylophagous attack. (fig.1) The action of the xylophagous insects (involving cellulose and lignin consumption by larvae, and realization of the flight orifices by adults) made the support frial, by reducing its mechanical strength. All these actions resulted in the loss of some parts of the woody material which, in their turn, affected the integrity of the afferent painted layer. The superior arch of the iconostasis is highly deteriorated, fragments of decorations missing. Although, initially, the other elements of the object seemed in quite a good condition, it was letter observed that the xylophagous attack had considerably affected its mechanical strength. The attack is evident, too, on the front side of the icons, through similar flight orifices and galleries made by insects. (fig.2) Although the orifices are not all present on the front side of the icon, they created some air bags between the support and the painted layer and, implicitly, affected its adherence, which provoked e.g., blind detachments in the roof. The action of the microfungi attack is put into evidence by some chromatic alteration appearing either as blots of different colours on the surface of the painting, or as fissures and detachments of the painted layer. The amplitude of the fungi' and insects' attack is caused by the nutritive source present inside the iconostasis on one hand and by the conditions (unsuitable parameters of the church's microclimate) favourizing their installations and development – on the other.

The investigations led to the identification of the *Anobium punctatum* De Geer species and of fungi belonging to 4 genera: *Cladosporium* Link; *Penicillium*; *Rhizopus; Sporobolomyces*; *Alternaria*.

Anobium punctatum De Geer, 1774, characterized by a large areal of its occurrence, it is one of the most damaging species for human economy and cultural values. Its adults produce a characteristic noise when knocking the wood with their pronote, which explains the name they have been given: furniture beetle . They prefer certain types of wood (resinous essences, oak, willow, poplar, beech, limewood, sycamore maple, walnut), older, with rugosities, cracks or galleries, and having high humidity values – which is, maybe the most important element of all.

The duration of the larvary stage varies as a function of the available food, temperature, relative humidity, from a few month to several years, the number of stages a larva should cross being different, too. At a temperature of 0°C, the larvae cease to feed themselves, their optimum temperature for their development being of 20°C. The larvae dig irregular galleries in the wood, filling them with fine, cylindrical sawdust and excrements. The escape direction off the support is influenced either by humidity on by the air currents, larvae' movement occurring from a lower to a higher humidity. They develop endosymbiosis relations with various species of yeasts, bacteria, protozoa and microscopic fungi, with the help of which they succeed in digesting the lignin and cellulose from the wood.

As saprophyte organisms, the fungi possess a highly complex enzymatic equipment, by means of which they dissolve the organic substances present in the substrate, in view of a subsequent absorption of the hydrolysis products. In most cases, the action of the fungi is accompanied by that of the bacteria. A biodeteriogenous agents, the fungi act upon the substrate through mechanical, chemical and biochemical ways.

The wood - a support material for paintings, pieces of furniture, statues or building materials - is most highly deteriorated under the action of fungi, which are capable of developing - both on woods surface and inside it - medullary structures, parenchymatic ceels or tracheides.

The degradations they induce may be simple chromatic modifications, not affecting mechanical strength, or they may decompose the lignocellulosic material up to its complete decay. In this latter case, the fungi use an organic nutrition source, the components of the cell walls, which they hydrolyze into simple components, through the action of the exoenzymes released in the substrate (Vintilă, E.,1978).

In the case of paintings, they may affect all layers: support, ground, colour layer, varnish, the way in which the attack is developed depending equally on species and microclimate. Most frequently, they grow on the layer's surface, forming colonies appearing as stains of different colours, with either powdery or fluffy aspect. When removing the mycelium layer (formed on the external part), the substrate appears as stained by the metabolic products.

Sometimes, the fungi penetrate the colour layer and fissure it in the form of a network. Fibers' degradation by the numerous cellulosolytic microorganisms results in fissures, detachments of the colour layer off the support etc.

The wood employed as a support for paintings or sculptures becomes spongy and buttle. The glue, highly vulnerable to their action, looses its adhesive properties, which results in detachments of the colour pellicle, up to its pulverulence. Substrates' infection from the part of fungi may occur either from the surface of the picture towards the support, or viceversa. In the case of other fungi, a certain specificity of theirs for some of the painting's material components could be noticed.

Conclusions

Biodeterioration should be understood as a complex process, within which the interactions between the biodeterogeneous agent and the substrate are influenced by a series of factors, such as the microclimatic parameters: temperature, relative humidity, light, pH, ventilation, atmospheric composition or structure of the patrimonial objects, aspect related to the manner in which the various materials are utilized, or to some possible restoration actions.

The deterioration caused by insects and fungi are of major importance, which requires a severe control of such pests by means of preventive and curative measures.

A first step would be the elimination of insects (eggs, larvae, pupae, adults) by mechanical methods, followed by a series of chemical treatments, for a full eradication of the damaging species. Besides all these, correction of the values of the microclimatic parameters is absolutely necessary.

Rezumat

Dintre factorii implicați în deteriorarea bunurilor de patrimoniu cei mai agresivi sunt factorii biotici. Lucrarea de față își propune să prezinte principalii factori biologici implicați în deteriorarea iconostasului bisericii "Sfântul Nicolae" din satul Poieni, județul Iași.

Acknowledgement

The authors are especially indebted to Priest Iulian Negru for providing important information on the iconstasis under study, as well as to our colleague, Georgiana Gămălie, for the realization of the photographic materials.

References

1. BARNETT H.L., 1960 - *Illustrated Genera of imperfect fungi*, Ed. Burgess Publishing Company, Minneapolis , 49-52.
2. CANEVA G.; NUGARI M. P., SALVADORI O., 1994 - *La biologia nel restauro,* Nardini Editore, Firenze, 61-92.
3. IONIȚĂ I., 1974 - *Cercetări privind biologia ciupercilor care produc biodeteriorarea operelor de artă şi monumentelor culturale*, Bucureşti, 9-12.
4. MUSTAȚĂ M., 1998 - *Insecte dăunătoare bunurilor de patrimoniu*, Ed. Univ. "Al.I. Cuza", Iaşi, 128.
5. NICOLAUS K., 1998 - *The Restoration of Paintings*, Ed. Kőnemann, 13-27.
6. VINTILĂ E., 1978 - *Protecția lemnului şi a materialelor pe bază de lemn*, Ed. Tehnică, Bucureşti, 14-30.

Fig.1 - Degradation of the woody support under the action of insects and fungi

Fig.2 - Flight orifices on the surface of the painted layer

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 547 – 549

THE CONSERVATION CONDITION OF THE “PENTECOST” CHURCH OF HORODNICENI, DISTRICT OF SUCEAVA

MARIANA MUSTAŢĂ*, GEANINA BRATU*,
MINA MOŞNEAGU**

ABSTRACT

MUSTAŢĂ M., BRATU G., MOŞNEAGU M., 2006 - The conservation condition of the “Pentecost” Church of Horodniceni, district of Suceava. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 547-549.

The paper analyzes the conservation stage of the church of the Horodniceni village, district of Suceava, founded by Stephen the Great, as well as of the iconostasis belonging to this historical, cultural and religious site.

Keywords: conservation, monument, iconostasis, fungi, insects.

Introduction

Erected by Stephen the Great in 1502 and restored in 1539 by Mateiaş, one of the boyards of Petru Rareş, the “Pentecost” church represents a stone witness of the history and faith of our nation. The church, made of stone, has woody beams and floor. Its iconostasis, created in the XIX th century, obeys the five register structure of icons, all crowned by the Holy Cross and by the icons of Vergin Mary and St. John. The pictures, made on lime wood, was accieved in tempera with egg and in oil. The iconostasis also evidences rich-sculptured and polished decorations with geometrical and phytomorphous motifs. The hole monument appears in an advanced degradation stage, induced both by abiotic (temperature, humidity, light) and, especially, by biotic factors.

Materials and method

For a thorough characterisation of the monument’s, as well as of the iconostasis’ conservation condition, in situ macroscopical observations, photographic documentation and samples’taking over have been made. Numerous degradation signs appeared as having been caused by an active attack of the xylophagous insects upon the sculpture, icons from the iconostasis and, equally, upon the woody pieces inside the church (tetrapode, pulpit, chorus).

Also, the presence of the *Serpula lacrymans* Person species was observed on the walls, plaster, mortar, stone and woody parts of the monument. The highly developed mycelium created numerous problems, requiring urgent measures for stopping the attack (the first step to be taken referring to the removal of the contaminated earth inside the construction). Insects (both adults and larvae) and mycelia, filaments of fungi found on either the walls or woody parts, were taken over as biological material. Pests’identification was based on the microscopic observations performed in the laboratory.

Results and discussion

The elements of the iconostasis, the paintings and the sculptured wood were covered by an adherent layer of dust and filth, deposited especially on the sculptured parts. The colour and varnish layers evidenced fine fissures, which affected the clarity of the painting. Here and there, detachments or partial losses of the painting occurred.

The woody support had been degraded by xylophagous insects, 1-2 mm in diameter flying holes - out of which fresh sawdust, collected in numerous small heaps flew down - being found on the surface of the painting, which is an indication of an active attack. The number of surface orificies is quite low (not exceeding 15 orificies/dm^2) and unevenly distributed as, in some areas, no such an hole had been observed. The special intensity of the attack was evidenced exclusively in fractures and fissures, at the level of which numerous galleries,

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filled with fine sawdust, may be observed one near another, wood's mechanical strength being therefore quite low.

Samples'taking over permitted the identification of the main pest, which is *Anobium punctatum* DeGeer species (Coleoptera, Anobiidae), known as the furniture beetle (fig. 1). The adults' body subcylindrical in shape and 2,5 - 4,8 mm in lenght, is brown coloured. Characteristic to the species is the prothorax, covering the head almost entirely, the medio-posterior half evidencing a triangular proeminence, with no depression. The buccal apparatus is adapted to tearing and chewing. The pieces are provided with long and thick hairs, with the exception of the strongly-chitinized mandibles, having three sharps teeth. The mesosternum and the fore part of the metasternum show a deep depression specific to this genus, which protects the antennae. The elytrons, covering the abdomen completely, evidence obvious points, arranged in ten longitudinal rows, slightly disordered towards the apex. The posterior wings are well-developed, the coastal, subcoastal, radial, medio-external and anal nervures being visible. The feet, almost equal in lenght, just the coxes evidence different shapes (MUSTAȚĂ M., 1998). The coxa of the posterior legs is elongated along half of the metathorax width, the armour for the femurs having a slightly sinuous line.

With the proeminence occuring on the pronote, the adults hit the wood at specific frequencies, thus performing the sonorous communication between sexes.

The flight begins in May, continuing sometimes even in autumn, the insects being attracted either by light or by light-coloured surfaces. The females deposit about 50 eggs (in 2-3 series), in wood's cracks or in the old flying hole (PINNIGER D., 1994). The larva hatches through the portion attached to the substrate, which permits a direct penetration of the wood, inside which they dig galleries approximately parallel to the wood fiber.

The duration of the development cycle varies, as depending on the environmental conditions, from 6 months to 3 years, the optimum temperature for their development being around a value of 20^0C (HANSEN & co., 1996). Usually, the old wood, with high humidity values, softwoods with rugosity surface, cracks or galleries, are especially preferred (LIOTTA G., 1998).

The investigations made on the historical monument of Horodniceni evidenced, too, the attack of the *Serpula lacrymans* species, the installation and development conditions of the fungus being related to factors such as: high humidity, low aeration and presence of the nutritive substratum. Walls' humidity may have various sources: such as the foundation of the building or the materials decomposed by the fungus. In the church at Horodniceni, the high ratio of air's relative humidity is maintained, as well, by the conservation works initiated several years ago, by the absence of any heating source, which renders inevitable the formation of condense in the cold seasons of the year - all these favourizing, as generally known, a luxuriant development of the fungus. The attacked wood shows both longitudinal and transversal cracks, characteristic to the "cubic" rot (i.e., belonging to the category of the destruction rots), an intensely brown colour, low mechanical strength (under even low pressure, it easily breaks, being transformed into powder), as well as an ever-decreasing weight. The occurrence of the fungus in the walls may be explained by the presence, on the mortar, of calcium, an absolutely indispensable element for it (Bucşa L., Bucşa C., 2005).

Serpula (Merulius) lacrymans Person, 1901, (Hymenomycetes Meruliaceae), popularly known as the „sponge of the house" is a cosmopolitan species, largely occurrring in European countries, especially in the Northern hemisphere; it causes severe damages to the woody, as well as stone buildings, in the former case its attack being oriented towards the woody floors and doors' frames.

The mycelium develops inside and on the surface of the wood, thus degrading it, but equally on the neighbouring materials, by the development of hyphae appearing as a white-greysh-lilac coloured felt, with yellowish hues towards the extremity of the areas of external attack (under unfavourable conditions, the colour turns to yellow-orange). The water drops appearing on the surface of the mycelium explain the name given to the fungus: „lacrymans".

The rhysomorphs, shaped as more or less thick girdles, are developed inside the mycelium, providing the water and the feeding substances the fungus needs (fig. 2). With them, the fungus may enter cracks of the walls, covering all levels of the building, sometimes reaching the top framework. As, in most cases, the mycelium from which they had been developed gets destroyed, the rhysomorphs remain the only connection between the sources of food and the advancing hyphae.

The sporiferous body, formed inside the buildings, is fed by the vegetative mycelium of the fungus, occurring inside the substratum. Initially, it is light grey, a colour gradually, as its surface gets enlarged, turning to rust. It produces millions of spores, which may cover a whole wall or the whole floor with a rust-colored dust - which is actually the main characteristic of the „home fungus".

The fungus metabolizes everything, with the only exception of the collagen fiber; it may live on wood (the main and most preferred nutritive substrate of the fungus, paper, textiles, vegetal or animal alimentary products, the decomposition of the organic materials being performed by enzymes (secreted in the water impregnating the substrate). It shows a special touch, penetrating the wall in search of the wood (in spite of the fact that the wood may be present exclusively in foundations and on the roof). For its development it needs only a few minutes of humidity. Also, it may bring the water it needs from a considerable distance (fig. 3). The exigencies towards the external factors are variable, as depending on the development stages, as follows: optimum growing temperature ranges between 18-22°C; light is generally unfavourable to mycelium development. The fungus prefers the resinous and hardwood species, attacking less the oak, the chestnut, the cherry and the walnut tree. It never develops on an alkaline medium, the spores looking for an acid substrate; also, its development is better under conditions of low oxygenation (Bucşa L., Bucşa C., 2005). The favourable conditions for fungus growth are met when wood's cellular walls are completely impregnated with water (a humidity value exceeding 20% is required).

Conclusions

Blocking of the iconostasis degradation - as a result of insects' action - it should be taken down, moved and kept in a salubrious medium, under microclimate conditions favourizing its consevation (namely, a temperature around 20°C and relative humidity of 55%). Although such values appear as optimum for insects' development, too, they simultaneously increase the efficiency of some desinsection treatments.

The steps to be necessarily taken for combating fungus'development include: elimination of the contaminated material (by either burning or burial), localization and elimination of the excess of humidity (special attention should be paid to the foundation - phreatic level, to hydrogeological analyses on the places wheve water is usualy acummulated) application of repeated, serial treatments (as depending on the area, depth of the attack, on the materials entering), utilization of exclusively dry treated wood for preventing biodeterioration etc.

Rezumat

În această lucrare este prezentată starea de conservare a monumentului ştefanian din satul Horodniceni, Suceava, precum şi a iconostasului ce face parte din acest sit istoric, cultural şi religios.

Acknowledgement

The authors of the study extend their thanks to Priest Sălăjan C. for its constant support during the investigations, and for his active preoccupation for the recovery of the monument of Horodniceni.

References

1. BUCŞA L., BUCŞA C., 2005 - *Agenţi de biodegradare la monumentele istorice din România*. Ed. "Alma Mater", Sibiu, 126 .
2. HANSEN L. S., JENSEN K. M., 1996 - *Upper lethal temperature limits of the common furniture beetle* *Anobium punctatum* *(Coleoptera: Anobiidae.* International Biodeterioration & Biodegradation, Elsevier, 225-232.
3. IUGA G., 1979 – *Combaterea biodegradării în sistemul muzeal*. Ziridava XI, Muzeul Judeţean Arad, 1112 - 1117.
4. LIOTTA G., 1998 - *Gli insetti e i danni del legno*. Nardini Editore, Firenze, 151.
5. MUSTAŢĂ M., 1998, *Insecte dăunătoare bunurilor de patrimoniu*. Ed. Univ. "Al.I. Cuza", Iaşi, 128.
6. PINNIGER D., 1994 - *Insect pests in museum*. Archetype Publications, London, 58.
7. VINTILĂ E., 1978 - *Protecţia lemnului şi a materialelor pe bază de lemn*. Ed. Tehnică, Bucureşti, 14-30.

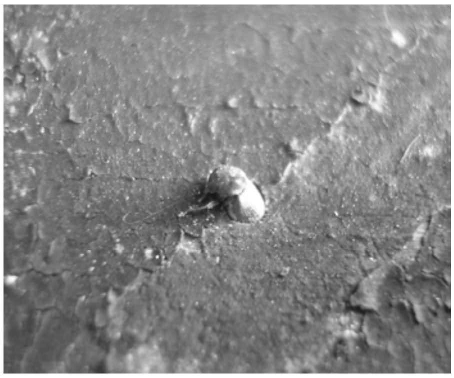

Fig. 1 - *Anobium punctatum* DeGeer

Fig. 2 - *Serpula lacrymans* - rhysomorphs

Fig. 3 - Wood attacked by *Serpula lacrymans*

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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THE TEMPORARY EXHIBITION "MUSHROOMS ARE WONDERS OF THE LIVING WORLD"

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NECULAI BARABAŞ*

ABSTRACT

PAVEL C. O., JIGĂU O., BARABAŞ N. , 2006 - The temporary exhibition "Mushrooms are wonders of the living world". *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 550-557.

The temporary exhibition "Mushrooms are wonders of the living world" was an important cultural and scientific event, which has contributed to spread the knowledge about edible and toxic mushroom species growing in the Bacău County. 130 species of macromycetes collected in the areas of Slănic-Moldova, Traian, and Tocila were displayed in these exhibitions according to scientific, esthetic and didactic criteria. The macromycetes species belong to 8 biological forms and 7 ecological categories.

Key words: macromycetes, exhibition, museum, Bacău

Introduction

With the title "European Heritage Days", the 16th edition, the Natural Sciences Museum Complex "Ion Borcea" in Bacău organized a series of cultural events: temporary exhibitions, a symposium, interactive educational activities.

The temporary exhibition "Mushrooms are wonders of the living world" has been organized by the Natural Sciences Museum Complex "Ion Borcea" in Bacău and the Mycological Society "Mihai Toma" from Romania during 26 th of September – 1st of October 2006.

At the opening of the exhibition which took place at the Vivarium of Bacău (28 September 2006) five mycologists from "Al. I. Cuza" University of Iaşi and 70 guests from Bacău County belonging to various local institutions: administration, culture, education and research, media, have participated.

The opening words were pronounced by Professor Dr. Neculai Barabaş, manager of the Natural Sciences Museum Complex "Ion Borcea" in Bacău. Other Professors such as Dr. Mihai Mititiuc, president of the Romanian Mycological Society, and Dr. Toader Chifu, vice-president of the same society, as well as Dr. Ortansa Jigău, our museum's curator of mycology, and Dumitru Popa, Secretary at the City Hall of Bacău gave speeches, stressing the importance of this exhibition and of the mushroom researches according to ecological and taxonomic criteria.

Otilia Pavel, curator of mycology, hosted the temporary exhibition of fresh mushrooms.

Further exhibitions were the following: the temporary exhibition "Forest treasures" realized by a group of experts from the Natural Sciences Museum Complex "Ion Borcea" in Bacău; a multimedia presentation hosted by Bogdan Barabaş, curator of museum techniques; the photo exhibition "A World of Mushrooms" realized by Lecturer Dr. Cătălin Rang (University of Bacău); a mushroom drawing exhibition made by Luminiţa Cojocaru.

The main topics of these exhibitions were the following: "the diversity of mushroom species in the Bacău County", "forest fruits used as food and medicines", "edible mushrooms", "poisonous mshrooms", "toxic mushrooms", "medicinal plants" and „the importance of wood in industry".

These temporary exhibitions also offered interactive educational activities, organized mainly for students. The events offered the visitors of Bacău the opportunity to learn about the mushrooms and the plants that grow in the forests of their county and to have a dialogue with the experts of the museum. In Romania nine exhibitions with fresh mushrooms have been organized by the Romanian Mycological Society until now; it has organized three exhibitions, together with the Museum of Bacău: at Slănic Moldova (1999), at the Vivarium of Bacau during 18-21 september 2004 and 30 September - 1 October 2005 (5, 6, 7, 8).

* "Ion Borcea" Natural Sciences Museum Complex

Material and method

Organizing the exhibition "Mushrooms are wonders of the living world" involved a series of activities specific to the making of this kind of the temporary exhibition: mycological applications in various habitats, the editing of propaganda materials.

The mycological material was collected while itinerary trips.

A 23-member group of museum curators and curatorial technicians participated in a 2-day activity of collecting various species of Macromycetes: this applications took place in 3 different areas in the Bacău County: Nemira Mountains (29 September 2006) on the road between Slănic – Moldova and Pufu (mixed of beech-fir-spruce forests, spruce tree); Ocol Silvic Traian – Dealu Morii, 26 september 2006 (deciduous trees and a pine plantations); around the village Tocila, 27 September 2006 (deciduous trees).

The collected mushrooms were analyzed in the mycological lab of the museum by museum curators Otilia Pavel and Ortansa Jigău, using the mycological reference books (1, 2, 3, 4, 10, 11).

The grouping of the exhibition was systematic, the classifications of Kirk and his associates (12). The clasification of the macromycets depending on the bioform (life form), the food value, the toxicity, was made after G. Sălăgeanu, 1985 (10).

Exhibits selected for the exhibitions were supervised by mycologists from Faculty of Biology of Iaşi and the Botanical Garden "Anastasie Fătu": Toader Chifu, Vasilică Chinan, Ana Cojocariu, Ciprian Bîrsan.

Results and discussions

The mushroom species presented into an temporary exhibition at Vivarium of Bacău, in 28 September 2006 (photos).

The 130 species of macromycetes identified belong to: 2 classes (6 Ascomycetes and 124 Basidiomycetes), 12 orders, 36 families, 65 genera (Table 1). The main genera being *Russula* with 16 species.

The macromycetes species belong to 8 biological forms and 7 ecological categories (Table 1).

The bioformes spectrum is dominated by Gm - mycetogeophyta mycorrhiza – 59 species (45,38 %).

The ecological spectrum is dominated by mycorrhizes species 59 (45 %), followed by saprophyte species 54 (42 %). The terricolous macromycetes, represented by 21 species.

From the edible mushrooms, 35 species have a low food value (X), 9 have a medium food value (XX) and 3 species have a very high food value (XXX).

Among rare species, we mention: *Cortinarius sulphurinus* Quél, *Mycena crocata* (Schrad.) P. Karst, *Flavoscypha cantharella* (Fr.) Harmaja, *Hericium coralloides* (Scop.) Pers.

The mycological material collected

Table 1

No.	**Kingdom FUNGI** **Species**	**1**	**2**	**3**	**Slanic - Moldova** 26 th Sept.	**Traian** 26 th Sept.	**Tocila** 27 th Sept.
	Phylum Ascomycota						
	Class Ascomycetes						
	Subclass Pezizomycetidae						
	Order Pezizales						
	Family Helvellaceae						
1	*Helvella crispa* (Scop.) Fr	Gs	St	X	+	-	-
	Family Pyronemataceae						
2	*Flavoscypha cantharella* (Fr.) Harmaja	Gs	St		+	-	-
3	*Scutellinia scutellata* (L.) Lambotte.	EPx	Sl		+	-	-
	Family Sarcoscyphaceae						
	Subclass Sordariomycetidae						
	Order Xylariales						
	Family Xylariaceae						
4	*Xylaria hypoxylon* (L.) Grev.	EPx	Sl		+	-	-
5	*Xylaria polymorpha* (Pers.) Grev	EPx	Sl		+	+	+
6	*Kretzschmaria deusta* (Hoffm.) P.M.D. Martin	EPx	Sl		+	+	-
	Phylum Basidiomycota						
	Class Basidiomycetes						
	Subclass Agaricomycetidae						
	Order Agaricales						

	Family Agaricaceae						
7	*Coprinus comatus* (O.F. Müll.) Gray	Th	St	XXX	+	-	-
8	*Lepiota aspera* (Pers.) Quél	Gs	St		+	-	-
9	*Macrolepiota mastoidea* (Fr.) Singer	Gs	St		+	-	-
10	*Macrolepiota procera* (Scop.) Singer	Gs	St	XXX	+	+	+
	Family Clavariaceae						
11	*Clavulina cinerea* (Bull.) J. Schröt	Gs	St	X	+	-	-
	Family Cortinariaceae						
12	*Cortinarius cyanopus* Secr. ex Fr.	Gm	M	XX	+		
13	*Cortinarius odoratus* (M.M. Moser) M.M. Moser	Gm	M		+		
14	*Cortinarius praestans* Cordier	Gm	M	XX	+	-	-
15	*Cortinarius trivialis* J.E. Lange	Gm	M		+	-	-
16	*Cortinarius sanguineus* (Wulfen) Fr.	Gm	M	†	+	-	-
17	*Cortinarius sulphurinus* Quél.	Gm	M	†	+	-	-
18	*Cortinarius variicolor* (Pers.) Fr.	Gm	M	X	+	-	-
19	*Gymnopilus penetrans* (Fr.) Murrill	Gm	M		+	-	-
20	*Inocybe rimosa* (Bull.) P. Kumm.	Gm	M	††	+	-	-
21	*Inocybe asterospora* Quél.	Gm	M	††	+	-	-
	Family Hydnangiaceae						
22	*Laccaria amethystina* Cooke	Gm	M	XX	+	-	-
23	*Laccaria laccata* (Scop.) Fr.	Gm	M	X	+	-	-
	Family Lycoperdaceae						
24	*Lycoperdon perlatum* Pers	Gs	St		+	-	-
25	*Lycoperdon pyriforme* Schaeff	EPx	Sl		+	-	-
	Family Marasmiaceae						
26	*Marasmius alliaceus* (Jacq.) Fr.	Gs	Sf		+	-	+
27	*Marasmius androsaceus* (L.) Fr.	Gs	Sf		+	-	+
28	*Xerula radicata* (Relhan) Dörfelt	Gs-EPx	Sl	X	+	+	+
	Family Mycenaceae						
29	*Mycena crocata* (Schrad.) P. Karst	Gs	St		+	-	-
30	*Mycena inclinata* (Fr.) Quél.	Ex-EPx	Sl		+	-	-
31	*Mycena pura* (Pers.) P. Kumm	Gs	St		+	+	+
32	*Mycena polygramma* (Bull.) Gray	Gs-EPx	St-Sl		+	+	+
33	*Mycena vitilis* (Fr.) Quél.	Gs	St		+	+	+
	Family Nidulariaceae						
34	*Cyathus striatus* (Huds.) Willd	EPx-Gs	Sl		+	-	-
	Family Pluteaceae						
35	*Amanita citrina* (Schaeff.) Pers.	Gm	M	†	+	-	-
36	*Amanita batarae* (Boud.) Bon	Gm	M		+		
37	*Amanita muscaria* (L.) Lam.	Gm	M	††	+	-	+
38	*Amanita pantherina* Gonn. & Rabenh.	Gm	M	††	+	-	-
39	*Amanita phalloides* (Vaill. Ex Fr.) Link	Gm	M	†††	+	-	+
40	*Amanita rubescens* Pers.	Gm	M	XXX	+	-	+
41	*Limacella guttata* (Pers.) Konrad & Maubl.	Gm	M	XX	+		
42	*Pluteus cervinus* P. Kumm.	EPx	Sl	X	+	+	-
43	*Volvariella gloiocephala* (DC.) Boekhout & Enderle	Gs	St	X	+	-	-
	Family Schizophyllaceae						
44	*Schizophyllum commune* Fr.	Ex-EPx	SPl		+	-	-
	Family Strophariaceae						
45	*Hypholoma capnoides* (Fr.) P. Kumm.	EPx	Sl		+		
46	*Hypholoma fasciculare* (Huds.) P. Kumm	EPx	Sl	†	+	+	+
47	*Hypholoma radicosum* J.E. Lange	EPx	Sl		+		
48	*Hypholoma sublateritium* (Schaeff.) Quél.	EPx	Sl		+	-	-
49	*Pholiota adiposa* (Batsch) P. Kumm.	Ex-EPx	SPl	X	+	-	-
50	*Pholiota aurivella* (Batsch) Fr.	Ex-EPx	SPl	X	+	-	-
51	*Pholiota squarosa* (Weigel) P. Kumm.	Ex	Pl		+	-	+

52	*Stropharia pseudocyanea* (Desm.) Morgan	Gs	St	X	+		
	Family Tricholomataceae						
53	*Armillaria mellea* (Vahl) P. Kumm.	Ex-EPx	SPl	XX	+	+	+
54	*Clitocybe candicans* (Pers.) P. Kumm.	Gs	Sf	†††	+	+	-
55	*Clitocybe gibba* (Pers.) P. Kumm	Gs	Sf	X	+	+	-
56	*Clitocybe odora* (Bull.) P. Kumm	Gs	Sf	X	+	-	+
57	*Collybia maculata* (A.S.:Fr) Kumm	Gs	Sf		-	+	-
58	*Gymnopus dryophilus* (Bull.) Murrill	Gs	Sf	X	+	+	-
59	*Gymnopus peronatus* (Bolton) Antonín	Gs	Sf		+	+	-
60	*Hygrophorus capreolarius* Kalchbr.	Gm	M	X	+	-	-
61	*Hygrophorus chrysodon* (Batsch) Fr	Gm	M	X	+	-	-
62	*Hygrophorus eburneus* (Bull.) Fr.	Gm	M	X	+	-	-
63	*Hygrophorus poetarum* R. Heim	Gm	M	XX	+	-	-
64	*Hebeloma radicosum* (Bull.) Ricken	Gm	M	X	+	-	-
65	*Lepista inversa* (Scop.) Pat.	Gs	St	X	+	+	-
66	*Tricholoma sejunctum* (Sowerby) Quél.	Gm	M		+	-	-
67	*Tricholoma saponaceum* (Fr.) P. Kumm.	Gm	M		+	-	-
68	Tricholoma *sulphureum var. sulphureum* (Bull.) P. Kumm.	Gm	M		+		
69	*Tricholomopsis rutilans* (Schaeff.) Singer	EPx	Sl		+	+	-
	Fam. Schizophyllaceae						
70	*Schizophyllum commune* Fr.	Ex-EPx	SPl		+	+	+
	Order Boletales						
	Family Gomphidiaceae						
71	*Chroogomphus rutilus* (Schaeff.) O.K. Mil	Gm	M	X	-	+	-
	Family Sclerodermataceae						
72	*Scleroderma citrinum* Pers.	Gm	M	†	+	-	-
	Order Polyporales						
	Family Fomitopsidaceae						
73	*Daedalea quercina* (L.) Pers.	Ex-EPx	SPl		-	-	+
74	*Fomitopsis pinicola* (Sw.) P. Karst.	Ex-EPx	SPl		+	-	-
	Family Hapalopilaceae						
75	*Bjerkandera adusta* (Willd.) P. Karst.	EPx	Sl		+	-	-
	Family Meripilaceae						
76	*Meripilus giganteus* (Pers.) P. Karst.	EPx	Sl		+	-	-
	Family Polyporaceae						
77	*Fomes fomentarius* (L.) J.J.Kickx	Ex	Pl		+	-	-
78	*Laetiporus sulphureus* (Bull.) Murrill	Ex	Pl	X	+	-	-
79	*Polyporus arcularius* (Batsch) Fr.	EPx	Sl		+	-	-
80	*Polyporus leptocephallus* (Jacq.) Fr	EPx	Sl		+	-	-
81	*Polyporus alveolaris* (DC.) Bondartsev & Singer	Ex	Pl		+	-	-
82	*Trametes gibbosa* (Pers.) Fr.	EPx	Sl		+	-	-
83	*Trametes hirsuta* (Wulfen) Pilá	EPx	Sl		+	-	-
84	*Trametes pubescens* (Schumach.) Pilát	Ex-EPx	SPl		+	-	-
85	*Trametes versicolor* (L.) Lloyd	EPx	Sl		+	+	+
	Subclass Phallomycetidae						
	Order Phallales						
	Family Geastraceae						
86	*Geastrum rufescens* Pers.	Gs	St		+	-	-
	Family Gomphaceae						
87	*Clavariadelphus pistillaris* (L.) Donk	Gs	St		+	-	+
88	*Ramaria aurea* (Sch.) Quél.	Gs	St	X	+	-	-
89	*Ramaria formosa* (Pers.) Quél	Gs	St	†	+	-	-
	Subclassa Tremellomycetidae						
	Order Tremellales						
	Family Exidiaceae						

90	*Guepinia helvelloides* (DC.) Fr.	Gs	St	X	+	-	-
91	*Pseudohydnum gelatinosum* (Scop.) P. Karst.	EPx	Sl	X	+	-	-
	Family Tremellaceae						
92	*Tremella mesenterica* Retz	EPx	Sl		+	-	-
	Incertae sedis						
	Order Cantharellales						
	Family Cantharellaceae						
93	*Craterellus cornucopioides* (L.) Pers.	Gm	M	X	+	-	-
94	*Cantharellus amethysteus* Quél.	Gm	M		+	-	-
95	*Cantharellus cibarius* Fr.	Gm	M		+	-	-
96	*Cantharellus tubaeformis* (Bull.) Fr	Gm	M		+	-	-
	Family Hydnaceae						
97	*Hydnum repandum* L	Gm	M		+	-	-
	Order Dacrymycetales						
	Family Dacrymycetaceae						
98	*Calocera viscosa* (Pers.) Fr.	EPx	Sl		+	-	-
	Order Gloeophyllales						
	Family Gloeophyllaceae						
99	*Gloeophyllum odoratum* (Wulfen) Imazeki	Ex-EPx	SPl		+	-	-
	Order Hymenomycetales						
	Family Hymenomycetaceae						
100	*Coltricia perennis* (L.) Murrill	Gs	St		+	-	-
101	*Hymenochaete rubiginosa* (Dicks.) Lév	EPX	Sl		+	-	-
102	*Phellinus igniarius* (L.) Quél.	EX	Pl		+	-	-
	Order Russulales						
	Family Bondarzewiaceae						
103	*Heterobasidion annosum* (Fr.) Bref	Ex-EPx	SPl	†	+	-	-
	Family Hericiaceae						
104	*Hericium coralloides* (Scop.) Pers.	Ex-EPx	SPl	X	+	-	-
	Family Russulaceae						
105	*Lactarius blennius* (Fr.) Fr.	Gm	M		+	+	+
106	*Lactarius chrysorrhes* Fr.	Gm	M	†	+	-	-
107	*Lactarius deliciosus* (L.) Gray	Gm	M	X	+	+	+
108	*Lactarius pallidus* Pers.	Gm	M		+	-	-
109	*Lactarius piperatus (L.) Pers.*	Gm	M	X	+	-	-
110	*Lactarius scrobiculatus* (Scop.) Fr.	Gm	M	†	+	-	-
111	*Lactarius subdulcis* (Bull.) Gray	Gm	M		+	+	-
112	*Lactarius volemus* (Fr.) Fr.	Gm	M	X	+	-	-
113	*Lactarius vellereus* (Fr.) Fr.	Gm	M		+	-	-
114	*Russula atropurpurea* (Krombh.) Britzelm.	Gm	M	X	+	-	-
115	*Russula aeruginea* Fr.	Gm	M	X	+	-	-
116	*Russula betularum* Hora.	Gm	M	††	+	-	-
117	*Russula cyanoxantha* (Schaeff.) Fr	Gm	M	XX	+	+	+
118	*Russula emetica* (Sch.: Fr.) Pers.	Gm	M	††	+	-	-
119	*Russula exalbicans* (Pers.) Melzer & Zvára	Gm	M		+	-	-
120	*Russula delica* Fr	Gm	M	XX	+	-	-
121	*Russula foetens* (Pers.) Pers.	Gm	M		+	+	+
122	*Russula integra* (L.) Fr.	Gm	M	X	+	-	-
123	*Russula lilacea* Quél.	Gm	M	X	+	-	-
124	*Russula ochroleuca* (Pers.) Fr.	Gm	M	X	+	-	-
125	*Russula olivascens* (Pers. ex Fr.) Secr. ss. Bres	Gm	M	X	+	-	-
126	*Russula puellula* Ebbesen, F.H. Møller & Jul. Schäff.	Gm	M	X	+	-	-
127	*Russula queletii* Fr.	Gm	M	†	+	-	-
128	*Russula versicolor* Jul. Schäff.	Gm	M		+	-	-
129	*Russula vesca* Fr.	Gm	M	XX	+	-	-
	Family Stereaceae						

130	*Stereum hirsutum* (Willd.) Pers	Ex-EPx	SPl		+	+	+
	Total species - 130				**127**	**26**	**24**
	1 Biological forms						
	Gm - mycetogeophyta mycorrhiza (micorrhizant mushrooms)	59			58	6	7
	Gs - mycetogeophyta saprophytica (saprophyte mushrooms)	27			26	9	7
	Gs-EPx - mycetogeophyta saprophytica - mycetoepixilophyta	2			2	2	2
	Th – mycetotherophyta (short living mushrooms)	1			1		
	EPx – mycetoepixilophyta (mushrooms whose life cycle takes place on dead wood)	22			22	6	3
	EPx-Gs - mycetoepixilophyta - mycetogeophyta	1			1		
	Ex – mycetonedoxilophyta (mushrooms whose life cycle takes place in the body of the wooden plants)	5			5		1
	Ex-EPx - mycetonedoxilophyta - mycetoepixilophyta	13			12	3	4
	2 Ecological category						
	M - mycorrhizal species		59		58	6	7
	Sf - saprothrophic species on leaf		8		7	5	3
	Sl -saprothrophic species on dead wood		25		25	7	4
	SPl - saproparasite species on wood		12		10	3	4
	Pl - parasite species on living trees		5		5		1
	St - saprothrophic species on soil or humus		20		21	4	4
	St-Sl - saprothrophic on humus or on dead wood		1		1	1	1
	3 Edible (Food values)			**47**	**46**	**10**	**7**
	X – eatable with little food value			35	34	7	3
	XX - eatable with a lot of food value			9	9	2	2
	XXX - eatable with great food value			3	3	1	2
	3 Inedible – without sign			**65**	**62**	**12**	**14**
	3 Toxicity			**18**	**18**	**2**	**3**
	† - mushrooms wich cause gastrointestinal intoxication			18	10	1	1
	†† - mushrooms wich cause intoxication of the nervos system			6	6		1
	††† - mushrooms wich cause fatal intoxication			2	2	1	1

Conclusions

The temporary exhibition “Mushrooms are wonders of the living world” was an important cultural and scientific event, which has contributed to spread the knowledge about edible and toxic mushroom species growing in the Bacău County.

130 species of macromycetes collected in the areas of Slănic-Moldova, Traian, and Tocila were displayed in these exhibitions according to scientific, esthetic and didactic criteria. The macromycetes species belong to 8 biological forms and 7 ecological categories

From the economic importance of view the most numeros are the inedible species – 65 (50 %), followed by the edible species – 47 (36 %) and toxic 18 (14 %).

The collection of Macromycetes at the Natural Sciences Museum Complex “Ion Borcea” in Bacău acquired 500 new specimens.

Photos by Otilia Pavel and Bogdan Barabaş

Varnishing-day of mushrooms exhibition titled "Mushrooms are wonders of the living world"

Rezumat

Expoziția temporară „*Ciupercile un miracol al lumii vii*" a fost organizată de Complexul Muzeal de Științele Naturii "Ion Borcea" Bacău, în colaborare cu Societatea Micologică „Mihai Toma" din Romania. Un număr de 130 de specii de macromicete, colectate din județul Bacău, din zona Slănic – Moldova, Tocila şi Traian, au fost expuse în cadrul expoziției (28 sepembrie – 1octombrie 2006), după criterii ştiințifice, estetice şi didactice. Din analiza categoriilor ecologice, se constată că cele mai numeroase sunt speciile micorizante 59 (45 %), urmate de macromicetele saprofite 54 (42 %).

Dintre macromicetele rare pentru România care au fost prezentate în cadrul expoziției, menționăm: *Cortinarius sulphurinus* Quél, *Mycena crocata* (Schrad.) P. Karst, *Flavoscypha cantharella* (Fr.) Harmaja, *Hericium coralloides* (Scop.) Pers.

Expoziția a fost cuprinsă în *Programul manifestărilor culturale şi ştiințifice* aprobate şi finanțate de Consiliul Județean Bacău, pe anul 2006.

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References

1. BECKER G., 2000 – *Champignons*. Gründ, Paris, 223 pp.
2. BON M., 1988 - *Champignons de France et d'Europe Occidentale*. Ed. Arthaud, Paris, 345 pp.

3. BON M., 1990 – *Les Hygrophores. Hygrophoraceae Lotsy*. Flore Mycologique d'Europe, 1, Documents Mycologiques, Mémoire Hors série N° 1 , 99 pp.
4. BON M., 1991 – *Les Tricholomes et ressemblents*. Flore Mycologique d'Europe, 2, Documents Mycologiques, Mémoire Hors série N° 2, 153 pp.
5. BON M., 1993 – *Les Lépiotes. Lepiotaceae Roze*. Flore Mycologique d'Europe, 3, Documents Mycologiques, Mémoire Hors série N° 4, 153 pp.
6. BON M., 1997 – *Les Clitocybes, Omphales et ressemblants*. Flore Mycologique d'Europe, 4, Documents Mycologiques, Mémoire Hors série N° 4, 181 pp.
7. BON M., 1999 - *Collybio-Marasmïoïdes et ressemblants*. Flore Mycologique d'Europe, 5, Documents Mycologiques, Mémoire Hors série N° 5, 171 pp.
8. CHIFU T., CONSTANTINESCU A., GOREA L., HUŢANU M., JALBĂ A., JIGĂU O., MITITIUC M., MANIC Ş, MARCOCI C., PÂRVU M., PAVEL O., ROBU T., ŞESAN T., TĂNASE C., 1999 – *Conspectul ciupercilor colectate cu ocazia celui de al IX-lea simpozion internaţional de micologie de la Slănic Moldova, august 1999. Studii şi Comunicări*, Compl. Muz. Şt Nat. Ion Borcea, vol. 17: 11 - 18.
9. JIGĂU O., PAVEL O., C, 2005 – *Expoziţia „Ciupercile valori ale patrimoniului naţional". Studii şi Comunicări*, Compl. Muz. Şt Nat. Ion Borcea, vol. 20: 176-182.
10. PAVEL O., JIGĂU O., 1999 – *Al XI-lea Simpozion de Micologie (26-28 august 1999).* Studii şi Comunicări, Compl. Muz. Şt Nat. Ion Borcea, vol. 17: 7 - 10.
11. PAVEL O., JIGĂU O., 2005 – *Expoziţia temporară „Lumea ciupercilor"*. Studii şi Comunicări, Compl. Muz. Şt Nat. Ion Borcea, vol. 20: 182 -1 90.
12. ROMAGNESII H., 1981 - *Petit guide des champignons*. Ed. Bordas, Paris, 229 pp.
13. SĂLĂGEANU GH., SĂLĂGEANU A., 1985 - *Determinator pentru recunoaşterea ciupercilor comestibile, necomestibile şi otrăvitoare din România*. Ed. Ceres, Bucureşti, 310 pp.
14. ŞESAN T., TĂNASE C., 2004 – *Ghid de recunoaştere a ciupercilor comestibile şi toxice*. Ed. Geea, Bucureşti, 72 pp.
15. *** http://www.indexfungorum.org/

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2006	Vol. 21: 558 – 561

THE CULTURAL PROGRAM "TODAY'S ASPECTS OF THE RELATION BETWEEN MUSEUMS AND SCHOOLS"

OTILIA CARMEN PAVEL*, NECULAI BARABAŞ*

ABSTRACT

PAVEL C. O., BARABAŞ N., 2006 - The cultural program "Today's aspects of the relation between museums and schools". *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea" Bacău, vol. 21: 558-561.

The program comprised a series of cultural activities: the symposium „Today's aspects of the relation between museums and schools", the activity „Through the museums of Europe", visits at the permanent and temporary exhibitions; debates, documentary materials; a poll. The poll was intended to see Bacău student preferences, interest and opinions. The project contributed to the exchange of experience concerning common projects between schools and museum, the paralleling and the improving of educational techniques for teachers and museum curators of Bacău.

Key words: educational project, museums, schools, symposium, Bacău

Introduction

During May-October 2006, at the Natural Sciences Museum Complex "Ion Borcea" Bacău there was an interactive programme: "Today's aspects of the relation between museum and schools".

This program has been financed and approved by the Bacău County Council and realized together with the School Inspectorate, based on the mutual protocol for 2006.

The host committee of the project was composed of: manager Neculai Barabaş; coordinators: curator Otilia Carmen Pavel; head of departament - Valeria Pavel; assistants: Gabriela Gurău, Bogdan Barabaş, George Roşu, Lăcrămiora Zaharia, Anca Tudor Andrei, Oana Adam, Florin Tofan, Maria Ciubotaru.

The aim of the project was: to spread the cultural, educational and scientific offering of the museum; to spread the values of the cultural treasures of the museum; to spread and begin some projects meant to optimize student access to the cultural acts.

Material and method

Methods used in activities: a) academic methods - a symposium, lectures, meetings; b) audio-visual methods – multimedia presentations; c) practical methods - visits at the permanent and temporary exhibitions; written methods – documentary materials, articles, questionnaires, posters.

Results and discussions

The symposium „Today's aspects of the relation between museums and schools" was hosted at the new building of the Natural Sciences Museum Complex „Ion Borcea" Bacău, on May 4, 2006, under the guidance of Professor Neculai Barabaş.

The event began with two oral presentations about questions of museum pedagogy: „New aspects of the educational function of the contemporary museums – Lecturer Venera Cojocariu, University of Bacău; „Museums between virtuality and reality"- Professor Neculai Barabaş (manager of Natural Sciences Museum Complex „Ion Borcea" Bacău).

Then, the program went on with a presentation by teacher Dumitru Ficuţă (of the School Inspectorate of Bacău) about „New aspects of the education through museums".

Further presentations about educational projects and museology matters have been discussed: teacher Cristina Ichimaş, „Grigore Antipa" High school Bacău – „The integration of the relation between museums and schools in extra-curriculum activities"; teacher Corina Bâra, School No. 10, Bacău - „Young nature explorers"; teacher Mioara Prisecariu, School „Mihai Drăgan", Bacău; Oana Adam, Bogdan Barabaş, Dorica Ţârdea - „Museums and schools as initiators of knowledge"; Delia Guşă, Ortansa Jigău, Natural Sciences Museum Complex „Ion Borcea" Bacău - „Complementary activities of museum and school"; Lăcrămioara Zaharia, Florin Tofan, Anca Tudor,

* "Ion Borcea" Natural Sciences Museum Complex

Natural Sciences Museum Complex „Ion Borcea" Bacău, „The interactive part of the relation between museums and the schools".

Various guests from cultural and educational institutions joined the symposium: 30 curators and conservators from the Natural Sciences Museum Complex „Ion Borcea" Bacău and the Museum of History „Iulian Antonescu"; 12 teachers from all levels of education (Bacău County); 45 students of Biology from the University of Bacău, 11 pupils from, „Grigore Antipa" High school, Bacău.

The activity ended with conclusions uttered by Lecturer Venera Cojocariu and teacher Dumitru Ficuță, who underlined the actual cooperation in interactive project between the museum and the school, as well as the value of the cultural offering for the young people of the Bacău County.

The activity „Through the museums of Europe" took place on Europe Day, May 9 and June 2, 2006. The event comprised multimedia presentations and projections of documentary films. 100 guests from the Natural Sciences Museum Complex „Ion Borcea" Bacău, Vivarium, "Victor Anestin" Astronomical Observatory, teachers, pupils and students from the Bacău County participated.

The program comprised: the presentation „The significance of Europe' Day and the symbols of the European Union"- Dr. Gabriela Gurău; Multimedia presentations: „Museums of France and Spain" – George Roşu; „Values of the European museums" – Lăcrămioara Zaharia; „The Tropicarium - Oceanarium in Budapest" – Otilia Pavel; „Sagrada Familia – an universal masterpiece" – teacher Cristina Ichimaş, Ioana Măciucă, „Grigore Antipa" High school, Bacău; „ The Aquarium in Barcelona" – teacher Cristina Ichimaş, pupil Antohi Daniela, „Grigore Antipa" High school Bacău; „The Science Museum of Barcelona – a place of scientific experiments"- teacher Cristina Ichimaş, „Grigore Antipa" High school, Bacău; „Birthplace of Copernicus in Toruń" – Andrei Laslău, Walter Babiaş, teacher Constantina Hulea, „M. Eminescu" High school; „Capadocia" – Andreea Enăşel, Simona Georgiana Spoină, teacher Constantin Hulea, „Mihai Eminescu" High school; „The Natural History Museum of Budapest"- Dr. Gabriela Gurău.

The activity represented for the participants to the event an important exchange of experience between curators and teachers who had joined European projects. Their aim was to identify common areas of interest for schools and museums. The event contributed to the expansion of European cultural values and to the consolidation of the importance of museums as educational resources for student learning and for teacher improving.

The debates hosted in this project targeted the making of the strategy of the museum during 2007-2008. Twenty teachers have been questioned to identify joint educational partnerships between museum and schools, main research areas and thematic such as: brochures, CD containing multimedia presentations of accomplished projects, banners, and posters.

The debates were also joined by four French teachers whose aim was to get informed, together with 16 high school students. The presentations of the collections and of the conservation techniques was done by manager Neculai Barabaş and the thematic guidance into every exhibition of the Museum were done by curators: Gabriela Gurău, Dorica Țârdea, Otilia Pavel.

The results of this consulting process were essential for the elaboration of cultural, scientific and educational programs concerning the period 2007-2008.

The questions and answers to the poll.

183 students from Bacău (4 schools and 4 high schools) were arbitrarily selected for a poll which took place in the course of June and July. The first 11 questions were addressed to all students, no matter whether they had previously visited all the sections of the complex or not. This poll was intended to assess Bacău student preferences, interest and opinions.

1. Age, Sex, class? The first question was answered by 183 students, variously aged between 11 and 19; 117 girls and 66 boys; 88 of them had gymnasium studies and 95 had high school studies.

2. Do you visit any kind of museums or particular kinds? (Multiple answer)

Any kind – 115

a) art museums – 16
b) history museums – 22
c) natural science museums – 49
d) ethnography museums – 3
e) memorial houses – 32

3. Which side of Natural Sciences Museum Complex „Ion Borcea" Bacău is your favorite? (Multiple answer)

a) Natural Sciences Museum Complex „Ion Borcea" Bacău – 63
b) Vivarium – 122
c) "Victor Anestin" Astronomical Observatory – 89
d) Memorial House „Ion Borcea" – 31

4. How important could be a visit to this museum? (One answer)

a) No importance – 6
b) Little importance – 11
c) Important – 78
d) Very important – 68
e) No answer – 20

5. Which are the exhibitions /exhibits that have really impressed you? (Free choice)

a) Natural Sciences Museum Complex „Ion Borcea" Bacău (basic exhibition) – 6
b) Vivarium (basic exhibition) – 8

c) “Victor Anestin” Astronomical Observatory –10
d) Memorial House „Ion Borcea” – 2
e) Temporary exhibitions – 25
f) Total of mentions (exhibits) – 135
g) No answer –20

6. Do you visit museums alone or with someone? (Multiple answer)
a) Alone – 14
b) With my school colleagues – 125
c) With my family –31
d) With my friends – 92
e) With a group of tourists – 42
f) No answer –2

7. What kind of guidance do you prefer? (Multiple answer)
a) Reading the labels of the exhibitions – 52
b) Thematic guidance – 45
c) Total guidance – 60
d) The website of the museum – 64
e) No answer –2

8. Do you think the information found in the museum is enough? (One choice)
a) Insufficient – 11
b) Satisfactory – 19
c) Interesting – 131
d) No answer – 2

9. Are you interested in specific themes for future exhibitions? (Free multiple choice)
Number of responders – 149
Proposed themes - 230
No answer – 2

Themes: Animals – 70; Anatomy – 7; Astronomy – 10; Aliens – 2; Astrology – 13; Art – 20; Diseases (prevention and fight against) – 10; Dinosaurs – 8; Geology – 3; Geography – 3; history – 14; Natural sciences – 5; Plants – 15; the protection of environment – 7; the birth and evolution of life and man on Earth – 20; the diversity of living world – 9; other themes – 12.

10. Are you interested in joining some specific cultural and educational activities hosted by the museum in 2006-2007? (Multiple answer)
a) Exhibitions – 91
b) Conferences -12
c) Symposiums – 9
d) Festivals – 63
e) Contests – 71
f) Film festivals – 58
g) Demonstrative lessons – 44
h) Summer courses – 56
i) Trips – 134
j) Cultural programs between museum and schools – 31
k) Scientific paper session – 16
e) No answer – 2

11. Please mention some suggestions concerning the side visited in our museum.
a) I don't know – 2
b) Proposals for new themes – 16
c) Completing the exhibitions with new exhibits – 29
d) Variations in propaganda materials – 8
e) Improving exhibition halls – 27
f) Others – 11
g) No answer – 100

Discussions

The situation of the general interest for museums is positive, 63 % of the subjects manifest their interest for all museum categories while 26 % choose only the natural sciences areas.

Among the sides of the museum, the Vivarium is preferred by 66 % while the Astronomical Observatory by 49 %.

The attitude towards the importance of visiting the museum is positive: 43% of the subjects think it is important and 37 % - very important.

A wide range of exhibits proved to be interesting; 135 mentions concerning exhibits of all sides have been noted; the students prefer living animals.

A great part of the students (68 %) visit the museum with their school, a fact which proves teacher’s preoccupation for these activities; those who visit it on their own are a good one (8 %).

There is a significant and authentic need for information and knowledge: 40% prefer brochure information and 33% wish total guidance.

Two thirds of the students think the information in the museum is interesting, a fact proving the value of the museum.

The themes proposed for organizing future exhibitions were chosen from various sciences and domains; 30% of the proposed themes were about animals.

Among the 11 cultural activities proposed for 2007, the favorite ones were: trips (73%), visiting exhibitions (50%).

Suggestions about the parts visited in the museum were made by 44% of the students and they reflected the knowledge of problems and the interest for variation and improving of spaces.

Conclusions

The project contributed to the exchange of experience concerning common projects between schools and museum, the paralleling and the improving of educational techniques for teachers and curators of Bacău.

The results of the poll which targeted the knowledge of Bacău students' preferences, interests, and opinions presented important landmarks in order to elaborate the strategy of the Natural Sciences Museum Complex „Ion Borcea” Bacău during 2007-2008.

Rezumat

Programul interactiv *„Dimensiuni actuale ale raportului muzeu - şcoală”* a fost realizat de un colectiv format din 12 muzeografi din cadrul

Complexului Muzeal de Ştiinţele Naturii „Ion Borcea” Bacău, care au colaborat pe parcursul desfăşurării proiectului cu 10 profesori din municipiul Bacău.

Proiectul s-a desfăşurat în perioada mai – octombrie 2006 şi a vizat: promovarea ofertei culturale, educative şi ştiinţifice a muzeului; popularizarea valorilor patrimoniului cultural din cadrul muzeului; popularizarea şi iniţierea de proiecte care urmăresc optimizarea accesului elevului /studentului la actul cultural.

Activităţile culturale au fost interactive şi variate: simpozionul *„Dimensiuni actuale ale raportului muzeu - şcoală”;* manifestarea – „*Prin muzeele europene*” (prezentări multimedia), mese rotunde pe teme privind relaţiile actuale dintre muzeu şi şcoli; ghidaje tematice desfăşurate la expoziţiile şi colecţiile din cadrul complexului, sondaj de opinie, activităţi de popularizare a ofertei culturale.

Sondajul de opinie a vizat cunoaşterea preferinţelor, intereselor şi opiniilor elevilor din municipiul Bacău, cu privire la activitatea Complexului Muzeal de Ştiinţele Naturii „Ion Borcea” Bacău, a fost făcut pe un eşantion de 183 de elevi.

Raportul cu analizele obţinute in urma sondajul de opinie şi a consultările purtate cu 10 profesori, din judeţul Bacău, a constituit un reper important în elaborarea unor programe culturale, ştiinţifice şi educative, ce au fost propuse de către muzeografi pentru 2007-2008.

Proiectele comune dintre muzeu şi instituţiile de învăţământ din Bacău, reprezintă un cadru strategic, deosebit de util atât pentru profesorii care folosesc deja muzeele drept resursă alternativă la educaţia formală şi nonformală, cât şi pentru specialiştii din muzee, al căror patrimoniu este astfel pus in valoare.

Parteneri ai proiectului au fost Consiliul Judeţean Bacău care a finanţat acest program şi Inspectoratul Şcolar Bacău.

References

1. COJOCARU V., BARABAŞ N., MITOCARU V., 1998 – *Pedagogie muzeală*. Centrul de Pregătire şi Formare a Personalului din Instituţiile de Cultură, Bucureşti, 228 pp.
2. FLORESCU R., 1994 – *Bazele Muzeologiei*. Bucureşti.
3. POPOVICI VARVARA, 2005 – *Parteneriat educativ*. Revista muzeelor, nr.1, Centrul de Pregătire şi Formare a Personalului din Instituţiile de Cultură, Bucureşti: 103 - 105.
4. http://www.dataarchive.ac.uk/support/teaching.asp
5. http://www.bio.uu.nl/scienceshop/
6. http://www.ucc.ie/hfrg/resources/#metho
7. http://www.kestionare.ro/www/Presentation/WhatCanDo.aspx

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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THE SCIENTIFIC ACTIVITY OF NICOLAE BOŞCAIU- MEMBER OF ROMANIAN ACADEMY

VASILE SANDA*, CLAUDIA D. BIŢĂ-NICOLAE *,
SORIN ŞTEFĂNUŢ*, NECULAI BARABAŞ**

SANDA V., BIŢĂ-NICOLAE C. D., ŞTEFĂNUŢ S, BARABAŞ N.2006 - The scientific activity of NicolaeBboşcaiu - member of Romanian Academy. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 562-568.

Mr. Nicolae Boşcaiu is born at 23rd of July 1925 in Caransebeş town. The primary studies had been efectuated between 1937 and 1945 at „Traian Doda” Lyceum at Caransebeş and those universitary between 1945 and 1949 at University of Cluj-Napoca. The doctorateship was earned in 1971 at the same university.

Our tentative to cast our eyes to the scientific activity of a great botanist not only of Romania but of the international level, must to consider the points of the begining of the researcher.

He was grow at the famous School of Phytocenology initiated at Cluj by Professor Al. Borza, where many researchers were educated. There always was a scientific emulated spirit, an adequated subsidy of literature and herbaria collection at Cluj. Moreover, here were compiled the first ***Exsiccata*** issues with many critical taxa of Romania.

The first studies were about the Gugu Mountain flora (1942) the Sebeşului Plain next to Zerveşti (1942), Muntele Mic (1944), where the author emphases the vegetal layer diversity.

Another orientation of research is observed through sistematic and anatomic studies of a few genus and species, as: *Bupleurum* (1964), *Peucedanum* (1965), *Veronica bachofenii* (1967), or those about emphasis new or rare species in Romania flora: *Potamogetum alpinus* (1967) and *Saponaria pumilio* (1993).

The fundamental opera wherefore he collaborated with Professor Al. Borza, „Introducere în studiul covorului vegetal” (1965), is a referent point for all botanic literature. The book described the most important Geobotany Schools, the methods of research, and also the first vegetation conspect of Romania.

The exceptional monography „Flora şi vegetaţia munţilor Ţarcu, Godeanu şi Cernei” described many new for science coenotaxa. Those are characterisated with many stational particularities, and were identificated again in other mountains. Likewise, the flora were for the first time cartographiated according to UTM system, and the semnificative map is attached at the end of the issue.

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Entire scientific opera of Mr. Nicolae Boşcaiu has as characteristic atribute a lapidary sentence where after his observations there are described the ecological characteres of the studied vegetal groups. For exemplification is the characterisation of fontinal vegetation of the the Ţarcu and Godeanu Massives (1971): „the stenostop characteristic of this ecological environmental had selected along time a well done complex of species from where are reconstructed through selectiv integration of the fontinal coenoses with a remarcable floristic conservatorism every time the erosive processes meet the ground water layer.

The next vegetation studies where also the activity of the researcher is remarcable through a few new taxa for science described: the Crişului Repede Defile (1966), mezo-xerotermic woody vegetation (*Orno-Cotinetalia*) of the Danube Defile (1971), the Maritim Dunes of Agigea (1975), the Carpathian Beech Forests Sintaxonomy (1982).

There were described many coenotaxa (see coenotaxonomic conspect) of Romania. This assumption a very good knowing of the vegetal layer and its dynamic in a more and more anthropogenic environment.

One of his main concerment is about the flora protection(1986-1989), natural parks (1982, 1993, 1994), protected arias (1989, 1995) or biosphere reserves (1998).

Student of School of Palinology that was initiated and directive by Emil Pop, member of Romanian Academy at Cluj-Napoca, Nicolae Boşcaiu elaborated in this area many and appreciated papers. Hereby there were studied: the Retezat Massif (1965, 1974), the Peştana Marsh (1971), the Lucina oligotrophic mire (1973), the Haiducilor Cave (1967), the Veteranilor Cave (1967), 'Frumos-Mosorasa' Lake (1982), the forests of the Cernei Mountains (1968) referring to the entire Carpatian-Ponto-Danubian area (1983). Those all are remarcable studies for the entire history of Romanian vegetation.

He also promoted the original directions of botanical research in Romania regarding to the aeropalinology, the sporo-polinic analyses in the cavernicol sediments, the diploidy index study of the vegetal communitis and the mathematic distribution aplication in the vegetation study.

The papers of histeriography: Al. Borza (1987), E. Pop (1974, 1997), Traian Săvulescu (1964) relieve the contribution of a few remarcable botanists for the development of the entire Romanian School of the vegetal world research. They are people who developed many domains applicable to the country economy.

Mr Dr. Nicolae Boşcaiu reputable an unanim scientific prestige both on national and international level.

He is chosen corespondent member of Romanian Academy (1990) and in the next year titular member (1991) but also president of the Romanian Society of Phytocoenology. He is honorary member of International Francofone of Phytocoenology Society. He is Doctor *honoris causa* of the University of Camerino (Italy 1998).

He participated at many congresses and symposia where through the presentated papers he set forth aspects of Romanian vegetal layer dynamic.

We presented shortly the main directions of research without to mention his hard work as editor-in-chief or member of editorial board of Academy issues *Studii şi cercetări de biologie*" seria *Biologie vegetală*, „*Revue de Biologie, Série de Bot.*" or *Ocrotirea Naturii şi Mediului Înconjurător*.

His work at the Nature Protected Commission and as supervizor for many Ph. D. Students materialized in many protected areas and reserves declarated but also in education of many researchers from all around Romania, a really Romanian School of Phytocoenology. It is remarcable that all his studens described in their thesis new for science coenotaxa: V. Alexiu, Silvia Oroian, Mihaela Sămărghiţan, Simona Mihăilescu, Daniela Stancu, Sorina Matacă, Claudia Biţă-Nicolae, Monica Neblea.

We related an exceptional career about a remarcable work, a life sacred to people education, sometime too unfairly, a person that knew to fight for the scientific values and to infuse them to the young people that have a change they would not dream.

THE DESCRIBED COENOTAXA CONSPECT AND THEIR SYSTEMIC FRAMING

SCHEUCHZERIO – CARICETEA FUSCAE Tx. 1937
CARICETALIA FUSCAE Koch 1926
CARICION FUSCAE Koch 1926 em. Klika 1934
Carici dacicae – Plantaginetum gentianoidis Boşcaiu et al. 1972
Carici dacicae- Drepanocladetum exannulatae Boşcaiu et al. 1972
ASPLENIETEA TRICHOMANIS (Br.-Bl.in Meier et Br.-Bl. 1934) Oberd. 1977
ANDROSACETALIA VANDELII Br.-Bl. in Meier et Br.-Bl. 1934
Asplenion septentrionalis Oberd. 1938
Asplenio trichomani – Poëtum nemoralis Boşcaiu 1971
Silenion lerchenfeldianae Simon 1957
Senecio glaberrimi – Silenetum lerchenfeldianae Boşcaiu, Täuber, Coldea 1977
ARTEMISIETALIA PETROSAE Sanda et al. 2001 (Syn.: **Potentilletalia caulescentis** auct. rom. non Br.-Bl. 1926)
Gypsophilion petraeae Borhidi et Pócs 1957

Saxifrago rochelianae – Gypsophiletum petraeae Boşcaiu, Täber, Coldea 1977
Saxifrago demissae – Gypsophiletum petraeae Boşcaiu et Täber 1977
Micromerion pulegii Boşcaiu (1971) 1979
Asplenio-Silenetum petraeae Boşcaiu 1971
Micromerio – Parietarietum murale Boşcaiu 1971
Asplenium lepidi Boşcaiu 1971
THLASPIETEA ROTUNDIFOLII Br.-Bl. 1926
THLASPIETALIA ROTUNDIFOLII Br.-Bl. 1926
Papavero-Thymion pulcherrimi I. Pop 1968
Cerastio lerchenfeldiani – Papaveretum Boşcaiu et al. 1977
Doronico columnae – Rumicetum scutati Boşcaiu et al. 1977
Saxifragetum moschatae – aizoidis Boşcaiu 1971
Cerastio transsilvanici – Galietum lucidi Monica Boşcaiu, N. Boşcaiu, Fr. Ehrendorfer1998
Saxifrageto aizoidis – Rumicetum scutati Boşcaiu 1971
Achnatherion calamagrostis Br.-Bl. 1918
Sedo fabariae – Geranietum macrorrhizi Boşcaiu et Täber 1977
Parietarieto – Galietum lucidi Boşcaiu et al. 1966
ANDROSACETALIA ALPINAE Br.-Bl. 1926
Veronicion baumgartenii Coldea 1991
Saxifrago bryoides – Silenetum acaulis Boşcaiu et al. 1977
Festucion pictae Krajina 1933
Festuco pictae – Senecionetum carniolicae Lungu et Boşcaiu 1981
SALICETEA HERBACEAE Br.-Bl. 1947
ARABIDETALIA COERULEAE Rübel 1933
Salicion retusae Horv. 1949
Anemono – Salicetum retusae Boşcaiu 1971
JUCETEA TRIFIDI Klika et Hadac 1944
CARICETALIA CURVULAE Br.-Bl. 1926
Caricion curvulae Br.-Bl. 1925
Potentillo chrysocraspedae – Festucetum airoidis Boşcaiu 1971
Loiseleurio – Vaccinion Br.-Bl. 1926
Cetrario – Vaccinietum gaultherioidis austro – carpaticum Boşcaiu 1971
SESLERIETEA ALBICANTIS Br.-Bl. 1948 em. Oberd. 1978
SESLERIETALIA ALBICANTIS Br.-Bl. 1926
Festuco saxatilis – Seslerion bielzii (Pawl. et Walas 1949) Coldea 1984
Seslerio haynaldianae – Saxifragetum rochelianae Boşcaiu 1971
Poo molinerii – Festucetum pachyphyllae Boşcaiu (1970, mnsc.) Boşcaiu et al. 1978
Seslerion rigidae Zó lyomi 1939
Festucetum xanthinae Boşcaiu 1971
BETULO-ADENOSTYLETEA Br.-Bl. et Tx. 1943
ADENOSTYLETALIA Br.-Bl. 1931
Delphinenion elati (Hadač 1969) Boşcaiu et Simona Mihăilescu 1997
Calamagrostion villosae Pawl. 1928
Chrysanthemo rotundifolio-Allietum victorialis Lungu et Boşcaiu 1981
Astrantio-Delphinietum elati Boşcaiu et Simona Mihăilescu 1997
MOLINIO-ARRHENATHERETEA Tx. 1937
MOLINIETALIA Koch 1926
Molinion caeruleae Koch 1926
Peucedano rocheliani-Molinietum caeruleae Boşcaiu 1965
FESTUCO-BROMETEA Br.-Bl. et R. Tx. ex Klika et Hadac 1944
STIPIO PULCHERRIMAE-FESTUCETALIA PALLENTIS Pop I. 1968
Seslerio-Festucion pallentis Klika 1931
Melico-Phleetum montani Boşcaiu et al. 1966
Bromo-Festucion pallentis Zólyomi 1966
Cerastio banatici-Festucetum dalmaticae Schneider-Binder E. et al. 1971
Thymo jankae-Festucetum dalmaticae Boşcaiu 1970 n.n.,
Poo badensis-Festucetum dalmaticae Boşcaiu 1970 n.n.,
FESTUCETALIA VALESIACAE Br.-Bl. et R. Tx. ex Br.-Bl. 1949
Pimpinello-Thymion zygoidi Dihoru 1969, 1970
Teucrio polii-Melicetum ciliatae Puşcaru V., N. Boşcaiu et Täuber 1978
FESTUCETEA VAGINATAE Soó 1968
FESTUCETALIA VAGINATAE Soó 1957
Scabiosion argenteae (Boşcaiu 1975) Popescu, Sanda 1987
Xeranthemo annuuo-Scabiosetum argenteae Boşcaiu 1975
SEDO – SCLERANTHETEA Br.-Bl. 1955
THERO – AIRETALIA Oberd. in Oberd. et al. 1967
Thero – Airion Tx. ex Oberd. 1957
Trifolio molinerii – Dasypyretum villosae Boşcaiu et Resmeriţă1967
ALYSSO – SEDETALIA Moravec 1967
Alysso petraei – Sedion albi Oberd. et Müll. ap. Müll. 1961
Alysso petraei – Sedetum hispanici Schneider-Binder et al. 1971
QUERCO-FAGETEA Br.-Bl. et Vlieger in Vlieger 1937 em. Borhidi 1996
FAGETALIA SYLVATICAE Pawlowschi in Pawlowschi et al. 1928
Symphyto-Fagion Vida 1959
subal. **Symphyto-Fagenion** (Vida 1959) Soó 1964
Galio rotundifolii-Fagetum Boşcaiu 1971
Aremonio agrimonioidi-Fagetum Boşcaiu 1971 in Remeriţă 1972
Subal. **Moehringio muscosae – Acerenion** Boşcaiu et al. 1982
Geranietum macrorrhizi Boşcaiu 1971
Subal. **Epipactido-Fagenion** Boşcaiu et al. 1982
Subal. **Lathyro hallersteinii-Carpinenion** Boşcaiu et al. 1982
QUERCETEA PUBESCENTI-PETRAEAE (Oberd. 1948) Jakucs 1960

QUERCETALIA CERRIS Borhidi 1996
Quercion petraeae Zólyomi et Jakucs in Soó 1963
Cytiso nigricantis-Quercetum cerris Boşcaiu et al. 1966
Syringo-Carpion orientalis Jakucs et Vida 1959
Echinopo banatici-Quercetum pubescentis Boşcaiu et al. 1971
VACCINIO-PICEETEA Br.-Bl. in Br.-Bl. et al. 1939
JUNIPERO-PINETALIA MUGI Boşcaiu 1971
Junipero-Bruckenthalion (Horv. 1949) Boşcaiu 1971

SCIENTIFIC PAPERS

1. BORZA AL., BOŞCAIU N., 1965, Introducere în studiul covorului vegetal. Bucureşti. Edit. Acad. R.P.R., 340 pg.
2. BORZA AL., BOŞCAIU N., 1967, Systematiche und zönologische Betrachtungen über die Art *Veronica bachofenii* Heuff. Revue Roum. de Biol. Série Bot. **12**(2-3): 131-135.
3. BOŞCAIU MONICA, BOŞCAIU N., EHRENDORFER FR., 1998, The *Cerastium alpinum* group (*Caryophyllaceae*) in the South-Eastern Carpathian. Contrib. Bot. Cluj-Napoca (1997-1998), **24**:5-37.
4. BOŞCAIU N., 1942, Flora luncii Sebeşului de lângă Zerveşti. Natura **31**(2):64-66.
5. BOŞCAIU N., 1942, Muntele Gugu. Natura, **31**(11-12):405-407.
6. BOŞCAIU N., 1943, Iedera (*Hedera helix* L.). Natura **32**(7-8):263-265.
7. BOŞCAIU N., 1944, Contribuţie la flora şi vegetaţia muntelui Mic din Banat. Primăvara Banatului, Lugoj, **5**:(8-13).
8. BOŞCAIU N., 1964, Trajan Savulesco (obituary). Vegetatio, **12**(3-4).
9. BOŞCAIU N., 1965, Cercetări fitocenologice asupra asociaţiei *Peucedano (rocheliani) - Molinietum caeruleae* din Banat şi Ţara Haţegului. Contrib. Bot. Cluj, 251-264.
10. BOŞCAIU N., 1966, Consideraţii asupra vegetaţiei actuale. În: Flora şi vegetaţia rezervaţiei naturale “Defileul Crişului Repede”. Contrib. Bot. Cluj-Napoca,161-164.
11. BOŞCAIU N., 1966, Vegetaţia acvatică şi palustră din împrejurimile oraşului Lugoj. Contrib. Bot. Cluj, II, 69-80.
12. BOŞCAIU N., 1970, Flora şi vegetaţia munţilor Ţarcu, Godeanu şi Cernei. Rezumatul tezei de doctorat. Cluj.
13. BOŞCAIU N., 1970, Pajişti din alianţa *Cynosurion* din munţii Banatului. Studii şi Cerc. de Biol. Seria Bot. **22** (5): 363-370.
14. BOŞCAIU N., 1971, Flora şi vegetaţia munţilor Ţarcu, Godeanu şi Cernei. Edit. Acad. R.S.R., Bucureşti, 494 pg.
15. BOŞCAIU N., 1971, Vegetaţia fontinală din munţii Ţarcu, Godeanu şi Cernei. Muz. Brukenthal. Studii şi Comunic. Şt. Nat. Sibiu, **16**:123-133.
16. BOŞCAIU N., 1971, Indici de diploidie ai unor asociaţii din munţii Ţarcu, Godeanu şi Cernei. Studii şi Cerc. de Biol. Seria Bot. **23**(2):151-158.
17. BOŞCAIU N., 1972, Pajişti xerice (*Festuco-Brometea* Br.-Bl. 1943) din depresiunea Caransebeş-Mehadia. Acta Bot. Horti. Buc. 1970-1971, Bucureşti, 449-468.
18. BOŞCAIU N., 1973, Interpretarea informaţională a spectrelor areal-geografice ale unor asociaţii vegetale din munţii Ţarcu, Godeanu şi Cernei. Muz. Brukhental. Studii şi Comunic. Şt. Nat. Sibiu, **18**:101-108.
19. BOŞCAIU N., 1973, Perspectivele cercetării operaţionale pentru conservarea ecosistemelor şi a mediului ambiant. Ocrot. Nat., **17**(1):69-76.
20. BOŞCAIU N., 1975, Aspecte de vegetaţie din rezervaţia dunelor maritime de la Agigea. Muz. Brukhental. Studii şi Comunic. Şt. Nat. Sibiu, **19**:81-93.
21. BOŞCAIU N., 1975, Problemele conservării vegetaţiei alpine şi subalpine. Ocrot. Nat. şi med. Înconj., **19**(1):17-21.
22. BOŞCAIU N., 1976, Vegetaţia potenţială şi importanţa sa pentru amenajările teritoriale şi reconstrucţia ecologică. Ocrot. Nat. şi med. Înconj., **20**(2):99-104.
23. BOŞCAIU N., 1979, L’integration phytosociologique du genofond végetal (plantes vasculaires) de la Roumanie. Documents phytosociologiques, N. S. Lille, **4**:88-108.
24. BOŞCAIU N., 1983, Unitatea spaţiului biogeografic carpato-ponto-danubian în lumina informaţiilor palinologice. Pădurea şi poporul român, Cluj-Napoca, 145-169.
25. BOŞCAIU N., 1986, Importanţa sistematicii pentru protecţia florei. Ocrot. Nat. şi Med. Înconj., **30** (2):121-123.
26. BOŞCAIU N., 1987, Un înaintaş al ocrotirii naturii în România: Profesorul Alexandru Borza (1887-1971). Ocrot. Nat. şi Med. Înconj., **31** (1):59-66.
27. BOŞCAIU N., 1989, Importanţa turbăriilor pentru conservarea unor relicte vegetale şi protecţia lor în România. Ocrot. Nat. şi Med. Înconj., **33**(2):139-141.

28. BOŞCAIU N., 2001, Ecosistemul şi importanţa funcţiilor sale protective. Ocrot. Nat. şi Med. Înconj, 1998-1999, **42-43**:13-21.
29. BOŞCAIU N., BOŞCAIU V., COLDEA GH., TÄUBER F., 1982, Sintaxonomia făgetelor carpatine, în: Făgetele carpatine. Semnificaţia lor bioistorică şi ecoprotectivă. Cluj-Napoca, 228-303.
30. BOŞCAIU N., CERNELEA E., COLDEA GH., LUPŞA V., PĖTERFI L., ŞT., PLĂMADĂ E., RESMERIŢĂ I., TÄUBER F., VICOL E., 1972, Studiu fitocenologic al pajiştilor din sectorul Hunedoara al văii Mureşului. Sagetia, Acta Musei Devensis. Series Şt. Nat., **9**:53-75.
31. BOŞCAIU N., COLDEA GH., HOREANU CL., 1994, Lista roşie a plantelor vasculare dispărute, periclitate, vulnerabile şi rare din flora României. Ocrot. Nat. şi Med. Înconj., **38** (1):45-56.
32. BOŞCAIU N., GERGELY I., 1966, Flora briologică În: Flora şi vegetaţia rezervaţiei naturale “Defileul Crişului Repede” Contrib. Bot. Cluj, I , 102-110.
33. BOŞCAIU N., GERGELY I., CODOREANU V., 1966, Conspectul asociaţiilor identificate. În: Flora şi vegetaţia rezervaţiei naturale “Defileul Crişului Repede” Contrib. Bot. Cluj, I, 164-167.
34. BOŞCAIU N., GERGELY I., CODOREANU V., RAŢIU O., MICLE F., 1966, Descrierea asociaţiilor vegetale, în: Flora şi vegetaţia rezervaţiei naturale “Defileul Crişului Repede”. Contrib. Bot. Cluj, 1, 167-258.
35. BOŞCAIU N., GERGELY I., RAŢIU O., MICLE F., 1966, Caracterizarea pedo-climatică a rezervaţiei În: Flora şi vegetaţia rezervaţiei naturale “Defileul Crişului Repede” Contrib. Bot. Cluj, I, 15-18.
36. BOŞCAIU N., GERGELY I., NICOLAE M., 1966, Analiza areal-geografică a florei. În : Flora şi vegetaţia Rezervaţiei Naturale “ Defileul Crişului Repede ”. Contrib. Bot. Cluj, I, 150-155 .
37. BOŞCAIU N., LUPŞA VIORICA, 1967, Palynological research in the “Grota Haiducilor” cave near the Herculaneum Spa (Romania). Rev. Roum. Biol. Série Bot., **12**(2-3):137-140.
38. BOŞCAIU N., LUPŞA VIORICA, 1967, Cercetări palinologice în Peştera Veterani din Defileul Dunării. Contrib. Bot. Cluj., 39-46.
39. BOŞCAIU N., LUPŞA VIORICA, RĂDOI TR., 1982, Analiza sporolonică a turbei din mlaştina Lacul Frumos-Mosoroasa (Jud. Vâlcea). Ocrot. Nat. şi med. Înconj. **26**(1-2):82-85.
40. BOŞCAIU N., LUPŞA VIORICA, RESMERIŢĂ I., COLDEA GH., SCHEINEDER ERIKA, 1971, Vegetaţia lemnoasă mezo-xerotermă (*Orno-Cotinetalia*) din Defileul Dunării. Ocrot. Nat., **15**(1):49-55.
41. BOŞCAIU N., LUNGU LUCIA, SEGHEDIN T., 1978, Cercetări sintaxonomice în rezervaţia botanică Ponoare-Bosanci (Jud.Suceava) I. Variaţiile ariei minime şi indicatori informaţionali într-o serie de asociaţii imbricate. Studii şi Comunic. de Ocrot. Nat. Suceava, **4**:375-393.
42. BOŞCAIU N., MAROSSY ANA, 1979, Aspecte de vegetaţie de pe valea Cepelor (masivul Biharia). *Nymphaea*, Oradea, **7**:301-321.
43. BOŞCAIU N., MIHĂILESCU SIMONA, 1997, Reconsideration of sintaxonomical position for *Delphinenion elati* aliance in the Romanian vegetation. Proceedings of the Institute of Biology, 37-40.
44. BOŞCAIU N., PĖTERFI L., ŞT., 1974, Aspecte de vegetaţie din cheile Crivadiei (Jud. Hunedoara). Sargetia. Acta Musei Devensis. Seria Şt. Nat., **10**:223-229.
45. BOŞCAIU N., PĖTERFI L., ŞT., 1974, Vegetaţia stâncăriilor de la Vârful Poienii de lângă Ohaba de sub Piatră (valea Streiului). Sargetia. Acta Musei Devensis. Seria Şt. Nat., **10**:239-241.
46. BOŞCAIU N., PĖTERFI L. ŞT., CERNELEA E., 1975-1976, Pajişti higrofile şi mezohigrofile din depresiunea Haţegului. Sargetia. Acta Musei Devensis., **11-12**:201-219.
47. BOŞCAIU N., PĖTERFI L., ŞT., PLĂMADĂ E., PREDA M., 1974, Complexul de mlaştini alpine şi subalpine din valea Judele (Parcul Naţional Retezat). Sargetia, Acta Musei Devensis. Seria Şt. Nat., **10**:69-77.
48. BOŞCAIU N., PLĂMADĂ E., PĖTERFI L., ŞT., 1972, Studii fitocenologice asupra complexului de mlaştini alpine şi subalpine din valea Judele-Parcul Naţional Retezat. Ocrot. Nat., **16**(2):175-185.
49. BOŞCAIU N., POP CÂMPEANU I., 1943, Note biografice: Doi arhierei români botanofili . Episcopul Filaret Musta.

Mitropolitul Al. Nicolescu. Bul. Grăd. Bot. Univ. Cluj la Timişoara, **23**(1-2):71-74.
50. BOŞCAIU N., PURDELEA LIGIA, 1989, Evaluarea stadiului actual al protecției florei României. Ocrot. Nat. şi med. Înconj., **33**(1):49-52.
51. BOŞCAIU N., RAȚIU FLAVIA,1964, Observații sistematice şi anatomice asupra unor specii de *Bupleurum* din Seria *Falcatae* Wolff. Contrib. Bot. Cluj., 307-320.
52. BOŞCAIU N., RAȚIU FLAVIA,1965, Observații sistematice şi anatomice asupra unor specii de *Peucedanum* din secția *Peucedanum*. Contrib. Bot. Cluj., 299-312
53. BOŞCAIU N., RAȚIU FLAVIA, NICOLAU M., 1968, Contribuție la istoria pădurii din Munții Cernei. SSB. Comunic de Bot., 73-77.
54. BOŞCAIU N., RESMERIȚĂ I., 1969, Vegetația ierboasă xerofilă de aluviuni din sectorul valea Eşelnița-valea Mraconiei al Defileului Dunării. Studii şi Cerc. de Biol. Seria Bot., **21**(3):209-216.
55. BOŞCAIU N., SORAN V., 1965, Considerations sur la distribution structurale d'un peuplement de pin sylvestre d'un marais oligotrophe (Roumanie).Vegetatio, **13**(2):88-96.
56. BOŞCAIU N., SORAN V., 1974, Academicianul Emil Pop. Studii şi Cerc. de Biol. Seria Bot., **26**(3):213-215.
57. BOŞCAIU N., SORAN V., DIACONEASA B., 1964, Contribuții la cunoaşterea Molinietelor din regiunea Oaş-Maramureş. Contrib. Bot. Cluj, 241-248.
58. BOŞCAIU N., TATOLE VICTORIA, 1991, Diversitate şi ecologie culturală. Ocrot. Nat.şi Med. Înconj., **35**(1-2): 43-48.
59. BOŞCAIU N., TONIUC N., PURDELEA LIGIA, 1997, Un protagonist al ocrotirii naturii din România: Profesorul Emil Pop (1897-1997). Ocrot. Nat.şi Med. Înconj., **41**(1-2):7-12.
60. BOŞCAIU N., TĂUBER F., 1978, Asociații vegetale rupicole şi petrofile din munții Piatra Craiului. (I). Studii şi Comunic. de Ocrot. Nat. Suceava, **4**:265-271.
61. BOŞCAIU N., TĂUBER F., 1980, Die zönogenetische Rolle der Hochstandenfluren in den Rumänischen Karpaten. Phytocoenologia, **7**:166-173.
62. BOŞCAIU N., TĂUBER F., 1985, Die zönologischen Verhältnisse der dazischen und dazisch-balkanischen Arten aus dem rumänischen Karpatenraum. Vegetatio, **59**:185-192.
63. BOŞCAIU N., TĂUBER F., COLDEA GH., 1978, Asociații vegetale rupicole şi petrofile din munții Retezatului. Studii şi Comunic. de Ocrot. Nat. Suceava, **4**:253-264.
64. BOŞCAIU N., TĂUBER F., RĂULEA MARIA, 1984, Aspecte de vegetație de la Râpa Roşie (Jud. Alba). Ocrot. Nat. şi med. Înconj. **28**(1):36-44.
65. DONIȚĂ N., IVAN DOINA, COLDEA GH., SANDA V., POPESCU A., CHIFU TH., PAUCĂ-COMĂNESCU MIHAELA, MITITELU D., BOŞCAIU N., 1992, Vegetația României. Editura Tehnică Agricolă, 407 pg.
66. IVAN DOINA, DONIȚĂ N., COLDEA GH., SANDA V., POPESCU A., CHIFU TH., BOŞCAIU N., MITITELU D., PAUCĂ-COMĂNESCU MIHAELA, 1993, Vegetation potentialle de la Romanie. Braun-Blanquetia, Camerino, **9**:3-79.
67. LUNGU LUCIA, BOŞCAIU N., 1981, O asociație nouă din Parcul Național Retezat. *Festuco pictae-Senecionetum carniolicae*. Acta Bot. Horti Buc. 1979-1980, 127-132.
68. LUNGU LUCIA, BOŞCAIU N., 1981, *Chrysanthemo rotundifolio-Allietum victorialis* eine neue Assoziation aus dem National Park Retezat. Analele Univ. Buc. Seria Biol., **30**:43-47.
69. POP E., BOŞCAIU N., 1974, Importanța Parcului Național Retezat pentru documentarea fitoistorică. Sargetia. Acta Mus. Devensis. Ser. Sci. Nat., Deva, **10**:41-45.
70. POP E., BOŞCAIU N., LUPŞA VIORICA, 1974. Nouvelle contribution á l'étude de l'histoire de la végétation du Parc National Retezat (Roumanie). Pollen et Spores, **16**(1):27-32.
71. POP E., BOŞCAIU N., LUPŞA VIORICA, RĂDULESCU DANIELA, 1971, Analiza sporo-polinică a sedimentelor de la mlaştina Peşteana (Jud. Hunedoara). Contrib. Bot. Cluj, 7-10.
72. POP E., BOŞCAIU N., PREDA M., MARCHIEVICI FR., 1973, Studiul palinologic şi pedochimic al unei argile glaciare din Parcul Național Retezat. Ocrot. Nat., **17**(2):159-163.
73. POP E., BOŞCAIU N., RAȚIU FLAVIA, DIACONEASA B., 1965, Corelația dintre aspectele polinice recente şi

vegetația din Parcul Național Retezat. Studii şi Cerc. de Biol. Seria Bot, **17**(1): 3-13.

74. POP E., BOŞCAIU N., RĂDULESCU DANIELA, 1973, Eficiența ecologică a măsurilor pentru protecția tinovului de la Lucina (Jud.Suceava). Studii şi Comunic. De Ocrot. Nat. Suceava, **3**:21-28.
75. PUŞCARIU VAL., BOŞCAIU N., 1982, Viitorul Parc Național al Munților Apuseni (II). Propuneri pentru organizarea şi funcționarea parcului. Ocrot. Nat şi Med. Înconj., **26**(1-2):5-19.
76. PUŞCARIU VAL., BOŞCAIU N., TÄUBER F., 1978, Aspecte de vegetație de pe Insula Popina din lacul Razem (Jud. Tulcea). Ocrot. Nat şi Med. Înconj., **22**(2):107-112.
77. RESMERIȚĂ I., BOŞCAIU N., COLDEA GH., LUPŞA VIORICA, SCHNEIDER ERIKA, STOICOVICI LUCIA, 1969, Contribuții floristice din Defileul Dunării. SSB. Comunic. de Bot., **10**:177-180.
78. RESMERIȚĂ I., VICOL E.C., BOŞCAIU N., TÄUBER F., 1972, Cartarea vegetației din sectorul valea Eşelniței-Trei Cule (Defileul Dunării). Studii şi Cerc. de Biol. Seria Bot., **24**(3):213-220.
79. SCHNEIDER-BINDER ERIKA, BOŞCAIU N., COLDEA GH., LUPŞA VIORICA, PLĂMADĂ E., RESMERIȚĂ I., STOICOVICI LUCIA, 1970, Zur Felsen-Vegetation der Sectoren Eşelnița-Mraconia und Kazan pass-Trikule (Durchbruchtal der Donau), I. Revue roum. de Biol. Sér. de Bot., **15**(5):311-322.
80. SCHNEIDER-BINDER ERIKA, BOŞCAIU N., COLDEA GH., LUPŞA VIORICA, RESMERIȚĂ I., 1971, Zwei neue xerotherme Felsengesellschaften aus dem Durchbruchtal der Donau. Revue roum. de Biol. Sér. de Bot., **16**(2):97-103.
81. SORAN V., BOŞCAIU N., 1967, *Potamogeton alpinus* Balb. O specie rară în Flora României. SSNG. Comunic. de Bot., **5**:115-118.
82. STANCU R., ALEXIU V., BOŞCAIU N., 1993, *Saponaria pumilio* în Masivul Iezer-Păpuşa. Ocrot. Nat.şi Med. Înconj., **37**(2):129-132.
83. TONIUC N., BOŞCAIU N., 1988, Rezervațiile biosferei în perspectiva programului internațional " Omul şi biosfera". Ocrot. Nat.şi Med. Înconj., **32**(1):11-18.
84. TONIUC N., LIGIA PURDELEA, BOŞCAIU N., 1993, Importanța ecologică şi culturală a parcurilor naturale. Ocrot. Nat.şi Med. Înconj., **37**(1):5-10.
85. TONIUC N., LIGIA PURDELEA, BOŞCAIU N., 1994, Rezervațiile biogenetice şi importanța lor pentru conservarea genofondului. Ocrot. Nat.şi Med. Înconj., **38**(2):107-113.
86. TONIUC N., LIGIA PURDELEA, BOŞCAIU N., 1995, Aspecte metodologice ale selectării şi gestiunii ariilor protejate. Ocrot. Nat.şi Med. Înconj., **39**(1-2):15-23.

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KUIPER BELT

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ABSTRACT

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The paper includes the history of the Kuiper Belt, a general presentation as well as the most important discoveries made in this outer region of the solar system. We briefly introduced the most important planetoids discovered in this belt together with the dwarf planets Pluto and Eris accompanied by a presentation of their main physical characteristics and their dynamic properties, trying to place them as precisely as possible in the group of celestial bodies that orbit the sun.

Keywords: comet nucleus, dwarf planet, planetoid, centaur.

After studying the orbits of comets, the Dutch astronomer Jan Oort introduced, in 1905, the hypothesis that a spherical cloud of comets surrounds the Sun at a distance of 50 000 AU. At about the same time, the Irish astronomer Kenneth Edgeworth and the Dutch astronomer Gerard Kuiper independently advanced the idea of the existence of a smaller disc-shaped cloud of comets that might orbit the Sun, immediately beyond Neptune. Both theories were trying to explain the different classes of comet orbits, the long-period comets coming from the Oort Cloud and the short-period comets from Kuiper Belt. After 1980, when more sophisticated computers were used to calculate the comet orbits, both theories became largely accepted.

Kuiper Belt, however, remained as a simple theory until 1992, when the astronomers Jane Luu and David Jewitt found the first object from Kuiper Belt, named 1992 QB1. For decades, the astronomers had used photographic plates to search for celestial bodies in the outer part of the Solar System, but there searches had been in vain. Luu and Jewill used a new technology, the CCD, with an increased sensitivity in comparison to the traditional photographic technology which allowed them to detect less bright objects. This first object discovered in Kuiper Belt is 1000 times less bright than Pluto. It has a diameter of 240 km, being bigger than the nucleus of an ordinary comet, but smaller than the 8 known planets, having approximately the same size as the asteroids and the planetary satellites. Briefly after that, more objects of similar dimensions have been discovered in the area of Kuiper Belt, confirming its existence. Today, more than 1000 such objects are known and they are named Kuiper Belt Objects or Trans-Neptunian Objects, having dimensions comparable with those of the asteroids, and some of them comparable to Pluto.

The objects discovered until now in Kuiper Belt have very interesting dynamic properties. They have a very uneven distribution of orbital elements, being thus divided in three distinct dynamic classes: classical objects, resonant objects and scattered objects.

Classical objects have, in their majority, the semi-major axes situates in the interval of 42 - 48 AU, and thus they never come closer to Neptune, which makes their orbits very stable. They are not extremely eccentric, but the orbit inclinations can reach impressive values (the greatest known value being 40^0).

Resonant objects are those bodies that are within or close to mean motion orbital resonance with Neptune. Their orbits are elliptical, and the most popular resonance with Neptune is 3:2. The bodies in this resonance complete two orbits around the Sun during the time that Neptune completes three. Pluto orbits in a 3:2 orbital resonance with Neptune. To mark this dynamic similarity with Pluto, these resonant objects were named *plutinos*. The 3:2 resonance may function as a stabilizer of the plutinos against Neptune's gravitational perturbations. The objects within this resonance can come close to Neptune's orbit without ever coming close to the planet, since during their cross to the perihelion they preferentially avoid the planet Neptune. Actually, it is well-known the fact that Pluto's orbit intersects Neptune's orbit, but the meeting between the two planets is always avoided. Plutinos orbit within a band situated at an average distance of 39 AU of the Sun. There have been discovered bodies in other different resonances with Neptune, among which 4:3 and 2:1. The classical

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and resonant objects form what we call the Classical Kuiper Belt, which stretches approximately between 30 and 50 AU from the Sun.

The third class of objects from Kuiper Belt is that of the *scattered disc objects*, comprising bodies with large orbits, very eccentric and very inclined. Their distance at the perihelion is around the value of 35 AU, and therefore Neptune manages to have a small dynamic control on them. In time, the perturbations at the perihelion exerted by Neptune modify the orbital parameters of these bodies, this class of objects possibly being an important source of short-period comets. The scattered objects go outside Kuiper Belt. For instance, 2000 OO67, whose perihelion is situated inside Kuiper Belt, has its aphelion situated at 1008 AU from the Sun, showing that the area of these scattered objects reaches at least up to this point.

Kuiper Belt surrounds the giant planets just as the Asteroid Belt surrounds the terrestrial planets. However, Kuiper Belt is different from the Asteroid Belt firstly since it was formed at a distance 10 time greater from the Sun that the latter, and secondly since it contains much more ice than the asteroids that are mainly made up of rocks and metals. Moreover, Kuiper Belt contains much more matter, possibly even 100 times more matter than the Asteroid Belt. It is believed that the objects in Kuiper Belt are debris from the exterior section of the disc of dust and gas out of which the planets were formed. The astronomers believe that the material in Kuiper Belt was too far from the Sun and too scattered to be able to coagulate in larger objects of the planet type.

The astronomers estimate that there are at least 70 000 objects with diameters larger than 100 km that orbit between 30 and 50 AU from the Sun. Kuiper Belt is important in the study of the planetary system at least for two reasons. Firstly, the objects in the belt probably represent extremely primitive and relatively intact remainders of the early phases of accretion of the Solar System. Secondly, Kuiper Belt is the main source of short-period comets. The study of this belt is a domain of research that evolves rapidly and in which there has been major theoretical and observational progress in the last years.

The Kuiper Belt objects discovered have so little brightness that getting information about the properties of their surface represented a real challenge. Their surfaces are rather dark, they reflecting between 3 and 15 % of the incident light. The data obtained show that the bodies have a lot of colors, from neutral hues of grey to nuances of bright red. This variety of colors shows a considerable variety of materials on the surface of the belt's objects, these different compositions being probably connected to the place in which and the temperature at which these objects were formed. Moreover, astronomers assumed that the surfaces of the objects in Kuiper Belt are dark and reddish as a result of the prolonged bombardment with cosmic radiation. This type of radiation leads to the selective loss of hydrogen from the surface materials, supporting at the same time, the formation of complex polymers, many of them dark and red due to the great amount of carbon in their composition. The same irradiated and carbonized material is believed to be responsible for the dark and refracting crusts of the comet nuclei.

In 2001 astronomers discovered that some objects in Kuiper Belt have satellites. The first binary object discovered, 1998 WW31, became famous due to its greatest orbital eccentricity measured up to now for any binary object in the Solar System or for any planetary satellite. The eccentricity of its orbit is of approximately 0,82, its orbital distance varying between 4 000 km and 40 000 km. The percentage of binary objects from the total number of objects discovered so far in Kuiper Belt is of 1 - 2%. But if we take into consideration the error of observation of very close binaries or of the binaries where the difference of brightness between components is great, we realize that the real percentage of binary objects in Kuiper Belt is much bigger. Surprisingly, the moons of these objects are much bigger in relation to the object around which they orbit if we are to compare them to the planetary moons and their parent planets. Whereas the majority of the planetary moons have diameters representing only a small percentage of the diameter of the parent planet, the moons of the Kuiper Belt objects discovered so far are usually half of the object around which they orbit. The study of binary objects can give us a lot of new data: by measuring the orbits of the components we can estimate their masses, and the mutual eclipses of their components allow us to determine their dimensions and densities.

The Kuiper Belt objects can suffer diverse perturbations during their lifetime, either due to Neptune, or due to close encounters or collisions with other objects in the belt, that may cause their being ejected towards the Oort Cloud or even in the interstellar medium, or they may be sent towards the interior of the Solar System, in the region of the giant planets. In 1977, the astronomer Charles Kowall discovered a celestial body that orbits between Saturn and Uranus, coming as close as 8.45 AU from the Sun at its perihelion and reaching, at its aphelion, a distance of 19 AU from the Sun. Having a diameter of 170 km, 20 times bigger than that of Comet Halley`s nucleus, and closer to that of a medium asteroid, this celestial body named Chiron was initially classified as an asteroid. But, coming closer to its perihelion, it started to develop a coma, proving to be a comet. If Chiron will ever be perturbed and sent on an orbit that will make it come close to the Sun, it will be a spectacular comet, indeed. Later on, other bodies whose orbits are situated between Jupiter and Neptune have been discovered - these objects are called *Centaurs.* Their characteristics are intermediate between asteroids and comets, and their range of colors is similar to that of the Kuiper Belt objects. The Centaurs have probably escaped from Kuiper Belt, but in dynamic terms, the Centaurs are objects belonging to Kuiper Belt, just as the asteroids that intersect the Earth's orbit belong to the Asteroid Belt. The Centaurs have very irregular and unstable orbits due to the perturbations that they undergo from the giant planets. In the case of an encounter with such a planet, a Centaur may collide with it or be ejected from the region of the giant planets, or it might be captured by the planet and become its satellite. Actually, some of the moons of the giant planets, especially those whose orbit is retrograde, are thought to be asteroids or Centaurs captured by the planet. Among these, we remark Triton, Neptune's moon. It is the only larger moon in the Solar System whose orbit around the parent planet is retrograde. It couldn't have been formed on such a retrograde orbit, being therefore a captured object, probably from Kuiper Belt. Triton's capture could also explain some of the irregular orbits of the other moons of Neptune. After being captured, Triton's orbit became very elliptical, but Neptune's powerful tidal forces modified it in time in a circular one. During this modification of its orbit, Triton eliminated all the other satellites with similar orbits from its vicinity. The other satellites are, indeed, at distances smaller than 117 000 km from the planet, whereas Triton orbits at a distance of 354 000 km from Neptune. It is possible that Triton might have also pushed the satellite Nereid on its strange orbit. Nereid has the most elongated orbit from all the satellites in the Solar System, the eccentricity of its orbit being of 0.75. Nereid's distance from Neptune varies from 1,35 million km up to 9,62 million km. Neptune's Trojans are probably captured Centaurs as well. These Trojans share Neptune's orbit permanently, forming an equilateral triangle with Neptune and the Sun.

As a larger and larger region of the skies was monitorised in search of new Kuiper Belt objects, the bigger and less numerous members were found. The diameters of these objects are close to the value of 1 000 km and make a connection between ordinary objects of the belt and the Pluto – Charon system. The first object found that has a dimension that comes close to 1 000 km was discovered in 2000, being named Varuna (2000 WR106). The diameter of this planetoid is estimated at the value of 900 ± 140 km. It orbits between 40.9 AU and 45.3 AU from the Sun, being therefore a classic Kuiper Belt object. In 2001, Ixion (2001 KX76) was discovered, with a diameter of 1065 ± 165 km. Ixion is a plutino orbiting the Sun between 29.9 AU şi 49 AU Another large object was discovered in 2002, being named 2002 AW197 and having a diameter around 900 km. Since it orbits the Sun between 41.3 AU and 53.6 AU , it was classified as a scattered disc object.

But the most important discovery in 2002 was the planetoid named Quaoar (2002 LM60). It was discovered on June 4th 2002, being, at the moment of its discovery, at more than 1.5 billion km beyond Pluto. The researchers later managed to identify Quaoar in archive images from 1982, 1996, 2000 and 2001. Managing thus to detect the object's trajectory for a period of 20 years, the astronomers finally determined Quaoar's orbit with a very accurate precision. Quaoar's orbit is almost circular and with a 7.9º inclination from the ecliptic plane. The orbit's perihelion is at 41.9 AU from the Sun and its aphelion is at 44.8 AU from the Sun, Quaoar thus being a classic Kuiper Belt object. Quaoar completes an orbit around the Sun every 288 years, being, most of the time, beyond Pluto's orbit. At its 1 250 km in diameter, Quaoar's volume is bigger than that of all the asteroids put together. But since it contains more ice than rock, Quaoar weighs only a third of the mass of the Asteroid Belt. Quaoar's color is grey and reflects 12% of the incident light, having thus a bigger albedo that all the other objects discovered so far in the belt.

In February 2004 was announced the discovery of another object of large dimensions, named Orcus (2004 DW), which at the moment of its discovery was at 2.4 billion km beyond Pluto. Orcus had at the moment of the discovery a magnitude equal to that of Quaoar, and, taking into consideration the fact that it was farther than Quaoar, it is possible that it is bigger that this. Its dimension was not measured precisely as in the case of Quaoar, but knowing the distance and its brightness and supposing that its albedo is equal to Quaoar's, its estimated diameter would be of 1400 km. Orcus' orbit is in a resonance of 3:2 with Neptune, being thus a plutino. The planetoid's orbit is at a 20.6º inclination from the ecliptic plane, and it stretches from 30.9 AU from the Sun at its perihelion up to 48.1 AU at its aphelion. Orcus completes an orbit around the Sun in 248 years, and the next perihelion passage will occur in 2113.

Shortly after Quaoar, the planetoid Sedna (2003 VB12) was discovered, which at the moment of its discovery was at 90 AU from the Sun. The object's diameter was initially estimated to have a value between 1 500 - 2 000 km, but the measurements done with the Hubble Space Telescope in April 2004 have established for Sedna a diameter of 1 600 km. The planetoid is remarkable for its bright red color: after Mars, it is the reddest body in the Solar System! The planetoid's surface is very bright as well, reflecting 20 - 25% of the incident light. The perihelion of Sedna's orbit is at 76 AU, and its aphelion at 990 AU, the orbit inclination being of 12º from the ecliptic plane. Objects that orbit up to farther distances from the Sun than Sedna have been found in Kuiper Belt, but the perihelion of all these objects is situated inside the Classical Kuiper Belt. Sedna's orbit is remarkable as its perihelion is situated outside the Classical Kuiper Belt. Moreover, its orbit's eccentricity is 0.857 and no other object in Kuiper Belt has such an elliptical orbit. The planetoid's orbit rather looks like that of the objects supposed to exist in the Oort Cloud. But Sedna is much closer than the distance predicted for the Oort Cloud. The astronomers believe that it might be a member of a significant additional population of bodies situated between Kuiper Belt and the Oort Cloud, named the Inner Oort Cloud. Sedna takes 10500 years to complete one orbit around the Sun. When it is at its perihelion, its surface temperature is -240ºC, and when it is at its aphelion the temperature drops up to -253ºC. Sedna revolves very slowly around its axis, the rotation period being of 40 days. By comparison, almost all solitary objects in the Solar System like comets and asteroids have rotation periods of a few hours. A possible explanation would be that the planetoid is a binary object and its rotation is regulated by a companion. Yet, recent observations with Hubble Space Telescope haven't detected any satellite around Sedna, at least not one of considerable dimensions that could slow down Sedna's rotation in such a degree.

But the most spectacular discovery in the Kuiper Belt was made in 2005, when the planetoid 2003 UB313 was discovered. Hubble Space Telescope determined that its diameter is of 2 400 ± 100 km, being thus larger than Pluto's! 2003 UB313 was named Eris after the Greek goddess of chaos and conflict since it generated numerous disputes in the astronomic community when its status was to be established. Though many astronomers considered that Eris is the 10th planet, the International Astronomic Union decided that a clearer definition of the notion of planet needed to be established, which was done at the Congress of the International Astronomic Union on August 24, 2006 in Prague. The basic conditions that a celestial body need to fulfill in order to be considered a *planet* were set then. These are: it needs to orbit around the Sun, to be big enough so that its shape be almost spherical and to have "cleaned the neighborhood" around its orbit of matter. It was decided that the bodies that fulfill only the first 2 conditions and are not satellites of a planet to be named *dwarf planets*. Thus, Eris finally received only the status of dwarf planet. Since the asteroid Ceres fulfills all the conditions set in the definition of the dwarf planet, it was also considered one, and Pluto, which, like Eris, does not fulfill the third condition, was demoted from the status of a planet to that of a dwarf planet.

The dwarf planet Eris has a very elliptical orbit, its perihelion being at 38 AU from the Sun and its aphelion at 97 AU from the Sun. Its orbit is also very inclined, forming 44º with the ecliptic plane. Eris needs 557 years to complete one orbit around the Sun. Whereas Pluto's surface is reddish and reflects 60% of the incident light, Eris' surface is almost white and brighter, reflecting 86% of the solar light. Around Eris only one satellite has been discovered so far and it was named Dysnomia.

Today, astronomers recognize the Kuiper Belt as the third main region in the Solar System, the first being that of the terrestrial planets and the second that of the giant planets. This recognition of its importance, combined with the scientific interest on Pluto and its satellites have determined astronomers to require the first mission of spatial exploration of this region of the Solar System. Thus, in 2001, NASA selected for financing the New Horizons Pluto - Kuiper Belt mission. New Horizons space probe was launched in January 2006 and after the gravity-assist flyby of Jupiter in March, 2007, it will reach Pluto in 2015. Then the probe will go deeper inside Kuiper Belt to study other of its objects. This probe will help us know more of the surface properties, the geology, the interior and the atmosphere of the Kuiper Belt objects. In time, astronomers will continue to use large telescopes from the ground together with Hubble Space Telescope to discover new objects of the belt and to find out more about this less known exterior region of the Solar System.

Rezumat

Lucrarea cuprinde istoricul Centurii lui Kuiper, o caracterizare generală a acesteia, precum şi cele mai importante descoperiri realizate în această zonă exterioară sistemului solar. Sunt trecuți în revistă cei mai mari planetoizi descoperiți în această centură, împreună cu planetele pitice Pluto şi Eris, fiind prezentate principalele caracteristici fizice ale acestor corpuri, proprietățile lor dinamice, încercându-se o încadrare mai precisă a acestora în ansamblul corpurilor ce orbitează în jurul Soarelui.

References

1. NIGEL HENBEST, 1992 – *Universe*. Macmillan Publishing Company, New York.
2. COLIN A. RONAN, 1991 - *The natural history of the Universe*. Macmillan Publishing Company, New York.
3. ROBIN SCAGEL, 2001 – *Spațiul*. Ed. Aquila'93, Oradea.
4. *** "L'Astronomie", Bulletin de la Société Astronomique de France, vol. 115, Jan./Febr. , 2001.
5. *** "Distant EKOs. The Kuiper Belt electronic newsletter", edited by de Joel Wm. Parker, no. 35, May 2004, www.boulder.swri.edu/ekonews .

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JUPITER – 35 YEARS OF SPACE EXPLORATION

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ABSTRACT

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The paper presents the history of the spatial exploration of the planet Jupiter. There is a presentation of all the space probes that overflew this giant planet, as well as the most important discoveries they made in the complex Jovian system: the shape and dimensions of the giant magnetosphere and of the radiation belts, the composition and dynamics of the planet's atmosphere, the geology of the Galilean moons, the discovery of some new satellites and of a ring system.

Keyword: space probe, jovian atmosphere, magnetosphere, satellite, rings.

Next to Jupiter, all the other planets of the Solar System seem insignificant. Even the ancient astronomers realized that Jupiter is special. They could not have known how big the planet was, and still, they named it after the supreme deity, the king of gods. Once the telescope was used by Galileo Galilei, the first more detailed information about this planet appeared, and once the observation techniques have perfected, the discoveries have been more and more numerous. But the real revolutionary step in our knowledge and understanding of this gigantic planet came with the beginning of its space exploration.

Launched by the americans 35 years ago, on March 3rd, 1972, Pioneer 10 was the first automatic space probe that flew by Jupiter. In December 1973, after almost 2 years of flight, it came as close as 130 000 km from Jupiter and it transmitted from there the first detailed images of the planet as well as data of the measurements carried out with the probe's equipment. Many instruments were installed on board such as the ones used for space photo shooting, radiation and meteorite detection, measuring magnetic fields, a photo-polarimeter for observing zodiacal light, a plasma detector for the study of the solar wind, optical telescopes, etc.

Once inside Jupiter's magnetosphere, Pioneer 10 confirmed that the planet has a very powerful magnetic field. As the probe had signaled that the solar wind was more intense only up to the asteroid belt, it was believed that Jupiter's magnestosphere might be symmetrical, because, at such a distance, the solar wind would be strongly diminished. But the moment the probe drew away from the planet, Jupiter surprisingly appeared to have a magnetic tail as well, even an enormous one, stretching over 800 million kilometers and sweeping the entire orbit of the neighboring planet, Saturn.

For four hours during the flight period, within 200 000 – 130 000 km from Jupiter, observations and measurements were done in such a way as to thoroughly study the Great Red Spot. The images captured by the probe were in visible radiation as well as in IR and UV radiation. The short-distance shots revealed a wide range of colors of the planet, these photos also being the first ones which showed that the visible cloud decks were located at different altitudes. In these images we can see small cells both in zones and in bands that indicate areas of extreme turbulence, vertical whirls like columns to support the gases towards the superior atmospheric strata. It is now believed that such a phenomenon generated the Great Red Spot.

The report on Jupiter's atmospheric composition sent by Pioneer 10 probe is: 82 % hydrogen, 17% helium and 1% heavy elements. After having measured the temperature of the atmosphere, the probe confirmed the fact that the planet has an internal source of heat that makes it generate 2.5 more energy than the one received from the Sun.

The study of the real trajectory of the probe allowed significant rectifications of the data previously established for Jupiter's mass and its gravitational fields, thus establishing that Jupiter's mass was larger than it had been believed.

The trajectory of the Pioneer 10 probe was set up so as to allow the study of the satellite Io. The movement of the probe showed that Io's mass was also larger than it had been believed as well as its

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density, which would imply the existence of an iron nucleus and a composition based on silicates. Around the satellite, the probe detected a thin atmosphere as well as an ionosphere. Pioneer 10 determined with a slightly smaller precision the masses of the satellites Ganymede and Callisto.

On April 6, 1973, a second space probe was launched towards Jupiter. Pioneer 11 had a similar organization and equipment with Pioneer 10. It reached Jupiter's magnetosphere a year after Pioneer 10, encountering the shock wave at a very different distance than Pioneer 10 and thus demonstrating that Jupiter's magnetosphere is very elastic. It expands and contracts considerably in accordance to the variable pressure of the solar wind that hits it.

In December 1974, Pioneer 11 came close to Jupiter, and whereas the orbit of Pioneer 10 had been almost equatorial, Pioneer 11 had a polar orbit, with the possibility to observe both poles of the planet. Pioneer 10 had "seen" only the south pole of the planet from a distance of 2 000 000 km, but Pioneer 11 looked at both poles from a distance of only 100 000 km. 7 hours before reaching the planet, Pioneer 11 took photos of the satellites Ganymede and Callisto, obtaining a very good image of Callisto and determining the masses of the two satellites with a greater precision than Pioneer 10. During the flight around Jupiter, Pioneer 11 drew as close as 34 000 km from the planet and photographed decks of clouds on which there were observed details three times smaller than in the previous mission, revealing convection movements in the explored atmosphere and going forward in the understanding of the general dynamics of this medium. The images of the Great Red Spot revealed its spiral structure with a counterclockwise rotation.

A remarkable achievement of Pioneer 11 mission was to determine the proportion of methane and ammonia in Jupiter's atmosphere as well as the proportion deuterium/ hydrogen, the evaluation of this proportion having a great importance in cosmogonic research.

The flights of the Pioneer 10 and 11 were in some way rehearsals for the flights of the Voyager probes, these being part of a more ambitious and sophisticated mission that followed the Pioneer mission. The american program named Voyager consisted of two identical automatic space probes that were launched in 1977 for the purpose of studying the giant planets, taking advantage of their alignment that takes place once in 176 years.

If, as far as the jovian system was concerned, the main mission of the Pioneer probes was to study the massive body of Jupiter, the two Voyager probes were mainly destined to the research of the galilean moons, as well as of the small satellite Amalthea that, at that time, was believed to be the closest to the planet.

Voyager 2 was launched towards Jupiter on August 20, 1977 and it was to reach the planet on July 9, 1979. Though launched later, on September 5, 1977, Voyager 1 was placed on a more direct trajectory, and so it reached Jupiter 4 months before Voyager 2. Thus, on March 4, 1979, Voyager 1 comes close to Jupiter, having 48 hours to study the planet and 5 of its satellites: it first flies around Amalthea, gets as close as 280 000 km from Jupiter, then passes by Io, Europa, Ganymede and Callisto. After 4 months, Voyager 2 flies at a distance of 643 000 km from the superior clouds of Jupiter, passing also by Ganymede, Callisto, Europa and Amalthea.

The measurements of Jupiter's magnetic field done by the Voyager probes revealed that the magnetic poles of the planet have a 11^0 inclination from Jupiter's rotation axis, and, moreover, the magnetic axis is shifted from the center of the planet by a 10th of Jupiter's radius. Therefore, the magnetic field at the surface of the clouds is not equal in every point; it differs the most between the northern and southern hemispheres.

When it came close to the planet, Voyager 1 observed an auroral arch on Jupiter's sky probably produced by the solar wind together with the electrically charged particles in the planet's magnetosphere. The photos of Jupiter taken during the flight showed details with a minimum diameter of 3 km in which one could notice colorful clouds, twisted and stretched in various shapes, cyclones bigger than Earth as well as lightning arches that cross the dense and turbulent atmosphere on distances greater than Earth's continents. The study of the Great Red Spot revealed that it absorbs matter from the surrounding regions at a speed of 100 m/s. This matter circulates for days inside the spot and is then violently ejected towards the east and the west. Voyager 1 managed to identify the gases composing it, such as ethane and hydrocyanic acid, as well as phosphorated hydrogen that erupts through this whirl from the inner atmosphere and, being exposed to the powerful UV radiation above the decks of clouds, it turns into red phosphorus. From the photos taken in the polar regions it is revealed that the clearly defined strata of band clouds reach the poles.

Voyager 1 was the probe that managed to photograph for the first time up close the irregular shape of the satellite Amalthea. The photos show that the small satellite has a reddish color that could be caused by the sulphur ejected from Io and set here. The satellite is elongated and its longer axis is always directed towards Jupiter. Near Amalthea, Voyager 1 discovered 3 more satellites of Jupiter. One, known as Thebe, orbits between Amalthea and Io, and the other two, Metis and Adrastea, orbit inside Amalthea's orbit.

When it reached Io, Voyager 1 made the most unexpected discovery of Jupiter's system. On Io, instead of impact craters, Voyager 1 discovered hundreds of craters created from the explosion or the collapse of some volcanic pits. Some of these craters belonged to active volcanoes! These were the first volcanoes in eruption discovered outside planet Earth. Drawn on one side by the giant planet Jupiter and on the other side by the other galilean moons, the matter inside Io is permanently deformed and heated, gushing periodically out under the shape of enormous volcanic eruptions. Voyager 1 observed that the ejected matter is primarily made up of sulphur compounds. The probe also observed that a small part of this material manages to escape from Io, forming a plasma ring that surrounds Jupiter as a huge belt or as a torus. This plasma torus has approximately the same shape and size as Io's orbit, but is slightly inclined so that it is found in the area of Jupiter's magnetic equator. Voyager 1 also detected the fact that the thin and rarefied atmosphere around Io is made up primarily of sulphur dioxide.

When Voyager 2 reached Io, it noticed that some volcanoes had stopped erupting whereas others had become active. Similarly it observed that the surroundings of these volcanoes had changed rapidly. A total of 9 active volcanoes were identified on Io by the two Voyager probes.

Voyager 1 obtained excellent images of Io, Ganymede and Callisto, but not of the satellite Europa. It remained to Voyager 2 to have the first more detailed images of Europa. These photos revealed that Europa's appearance contrasts powerfully with that of Io. The satellite Europa is covered with a thick layer of ice on which there are very few craters, but which is crossed by a complex network of dark lines. The tidal forces that heat the inside of Io have a smaller effect on Europa, but they are probably powerful enough to maintain inside the satellite the water in a liquid or semi-liquid state. It is, thus, possible that a water ocean may lie beneath the ice. The very small number of impact craters found on Europa puzzled the astronomers, but this fact can be explained if, at a certain point in the past, the water inside rose and flooded the surface of the satellite, covering it with a uniform layer of ice. On the other hand, the dirty water springing through the cracks in the ice could be the source of the dark lines that cross the surface of the moon. The data obtained by Voyager 2 regarding Europa's density indicate the fact that it has, just like Io, a solid interior made up of silicates.

Another satellite of Jupiter's visited by the Voyager probes is Ganymede, on which two contrasting types of terrain were found. The first one is composed of dark regions crossed by craters and long ditches, and the second one consists of bright areas crossed by cracks and striations that show the effects of surface and subterranean movements. The Voyager probes determined that Ganymede's density is much smaller than that of Io and Europa, being midway between the density of rock and that of ice. From the aspect of Ganymede's surface, it was noticed that this satellite of ice and rock presents the stigma of a special tectonics, connected to the expansion of ice during the deep structure changes. Ganymede's large albedo reveals the great percentage of ice on its surface and the numerous craters indicate that the age of its surface is 3 – 3.5 billion years, close to that of the Moon.

Unlike on Ganymede, on Callisto the Voyager probes did not notice signs of tectonic activity, but they found here even more craters than on Ganymede, which suggests that this satellite has the oldest surface from among all the galilean satellites. The density of Callisto obtained by the Voyager probes is similar to that of Ganymede, indicating the fact that Callisto too is made up of a mixture of rock and ice.

One more unexpected discovery was revealed in the last photos of Jupiter taken by Voyager 1. Jupiter's rings were seen for the first time in these images, automaton Voyager 2 being programmed to take supplementary photos. From these images we can see that Jupiter's rings are thin and dark, less spectacular than Saturn's and visible only in Jupiter's occultation of the Sun.

The next automatic space probe that visited the jovian system is the european probe Ulysses. It was launched on October 6, 1990 and it reached Jupiter on February 8, 1992. The main purpose of the probe was to study the solar wind and the interplanetary medium outside the ecliptic plane, as well as to fly for the first time around the poles of the Sun. Taking into account the fact that, nowadays, there is no rocket that could give a probe the necessary speed to launch it on an orbit so far from the ecliptic plane, the probe Ulysses was first sent towards Jupiter to benefit from the gravitational assistance of the planet, which allowed it to get out of the ecliptic plane and to come back towards the Sun to study its poles.

Ulysses obtained new data regarding the composition of the plasma in Jupiter's magnetosphere, especially concerning the degree of ionization of the different categories of ions. It monitored all three sources of ions: the solar wind, the planet itself and the volcanic satellite Io. It observed the great mixture especially of ions from the solar wind with those coming from Io, these two categories of ions being encountered in all the regions of Jupiter's magnetosphere that were investigated. This thing indicated that, on the one hand, the solar wind ions penetrate Jupiter's magnetosphere deeply and, on the other hand, the ions from Io travel outside the magnetosphere, both ions circulating both at low and at high latitudes.

Ulysses also revealed the fact that the ring of dusts that circles Jupiter stretches up to 600 000 km off the planet, thus much farther that it was believed and that the planet's radiation belts are flattened in comparison to those of Earth, concentrating on both sides of the equator at latitudes lower than 40^0.

Another probe sent towards Jupiter is the american probe Galileo. This was launched on October 18, 1989 and, after flying close to two asteroids, it reached Jupiter in 1995. In 1994, on its way towards Jupiter, it gave live observations of the planet's impact with Shoemaker-Levy 9 comet. Once close to Jupiter, Galileo launched a module that plunged inside the planet's atmosphere to measure its temperature, pressure, chemical composition, cloud characteristics, lightnings, etc. During its 59 minutes of life, the module went 200 km inside Jupiter's violent atmosphere before being crushed by the atmospheric pressure. It measured winds of 675 km/h and it encountered fewer clouds that was expected, the module apparently reaching a hotter and less cloudy area than the rest of the planet. The main body of the probe remained on orbit around Jupiter to study its atmosphere, the Galilean moons and its vast magnetosphere.

Galileo studied the volcanic activity on Io immortalizing numerous volcanic eruptions. The probe discovered that Io, though 3 times smaller than Earth, eliminates through its volcanoes twice more thermal energy and 100 times more lava than our planet, Io being thus the most volcanic celestial body in the solar system.

Galileo obtained substantial evidence that there is a salt water ocean underneath Europa's layer of ice. Jupiter's magnetic field changes its direction every 5.5 hours when it passes close to Europa. This shifting magnetic field can produce electric currents in an electric conductor such as an ocean. Such electric currents would produce, in their turn, a magnetic field having its magnetic poles close to Europa's equator and a continuously shifting position. Actually, this induced magnetic field would reverse its direction every 5.5 hours. During the first flights over Europa, Galileo identified a magnetic north pole, but it could not determine if its position changes in time. Further observations showed that it actually moves, proving that there is a subterranean ocean on Europa. It is not possible for these electric currents to circulate through the layer of ice, since ice is not a good electric conductor. But melted ice that contains salts, such as the water of the oceans on Earth is a fairly good electric conductor.

Flying over Ganymede, Galileo found that the satellite has quite a powerful magnetic field of its own. Still here, the probe also discovered a secondary magnetic field induced by Jupiter's magnetism, suggesting that there might be water on Ganymede as well. A layer of salty water a few kilometers thick at about 200 km under Ganymede's surface would clearly explain the data obtained. Natural radioactivity inside Ganymede's rocks would produce enough heat to preserve a stable layer of water at this depth.

The photo's taken by Galileo reveal that Ganymede's brighter areas are flatter than the darker ones and they are around 1 km lower than the darker areas. The researchers observed that these bright areas are similar to the terrestrial rifts, being partly filled with ice.

Similarly, the data taken by Galileo's magnetometer on Callisto also indicate the fact that the satellite may have a layer of salty water at great depth.

Cassini, the euro-american probe launched on October 15, 1997 towards Saturn, flew past Jupiter as well. In November 2000, Cassini was at the edge of Jupiter's magnetosphere, measuring the intensity of the solar wind that passed by the planet, whereas Galileo was inside the magnetosphere monitoring it. Thus, while Cassini monitored the fluctuations of the solar wind, Galileo investigated the responses of Jupiter's magnetosphere to these fluctuations. On December 30, 2000, Cassini flew by Jupiter at a distance of about 10 million km. Jupiter's images taken by Cassini with different filters reveal the structure and the movements of the clouds situated at different altitudes in the planet's atmosphere. Cassini's UV spectometer identified in Io's plasma clouds positive ions of oxygen and sulphur; monitoring the torus for a longer period of time, the probe noticed that it dissipates and becomes colder in time, being then recharged with particles and re-energized by the new volcanic eruptions on Io. Cassini's spectometer detected the chemical composition of the gas emanated by the volcanoes on Io. This gas contained oxygen, sodium, potasium and sulphur dioxide.

The jovian system is also studied in space by the Hubble telescope as well. It follows the evolution of the cloud structures on Jupiter, as well as the evolution of the Great Red Spot. For years, Hubble space telescope's UV camera monitors the auroras on Jupiter. Hubble took photos of numerous volcanic eruptions on Io and detected a very rarefied atmosphere made of oxygen on Europa and Ganymede, finding also ozone on the latter. Hubble telescope also photographed in 1994 the collision between Shoemaker-Levy 9 comet and Jupiter.

All these probes that visited Jupiter crossed regions of intense radiation, being confronted with the danger of colliding with asteroids and meteorites, and demonstrating that, eventually, it is possible for space ships to cross the asteroid belts and Jupiter's radiation belts and still be functioning. They transmitted data of an absolute novelty regarding Jupiter and its moons and recorded more data than hundreds of years of observation from Earth, and still, all this information is not enough to offer a complex image of this system. Jupiter's system still has many secrets to be revealed in the future space missions.

Rezumat

Lucrarea prezintă istoricul explorării spațiale a planetei Jupiter. Sunt trecute în revistă toate sondele spațiale care au survolat această planetă gigantă, precum şi cele mai importante descoperiri realizate de acestea în complexul sistem jovian: forma şi dimensiunile uriaşei magnetosfere şi a centurilor de radiații, compoziția şi dinamica atmosferei planetei, geologia sateliților galileeni, descoperirea unor noi sateliți şi a sistemului de inele.

References

1. ANDREESCU D., 1979 - *Enciclopedia programelor spațiale*. Military Publishing House, Bucharest.
2. DE LA COTARDIERE PH PERROT., J.-P., 1998 - *Dicționarul spațiului*. Univers Enciclopedic Press, Bucharest.
3. BREWER D., 1992 – Jupiter. Cherrytree Press, Bath.
4. SAGAN C., 1995 – *Cosmos*. Wings Books, New York.
5. HENBES N., 1992- *Universe*. Macmillan Publishing Company, New York.
6. MAMMANA D., 1990 - *Star Hunters*. Running Press, Philadelphia.
7. JONES B., 1994 - *An introduction to practical astronomy*. Grange Books, London.
8. COLIN A. RONAN, 1991 - *The natural history of the universe*. Macmillan Publishing Company, New York.

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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MARTIAN SPIRIT IN THE NEW SPATIAL ERA

DORICA ŢÎRDEA [*]

ABSTRACT

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Mars is the most studied planet after Earth. Overall, 37 probes were sent towards the Red Planet and only 18 managed to reach it, and out of 11 missions destined to land on Mars, only 6 transmitted data from there. The new discoveries made by the probes Mars Global Surveyor, Mars Odyssey, Mars Express and Mars Exploration Rovers pointed out the presence of water under the surface of the planet and studying the distribution of water will help us in search of Martian life. Today, there are investigations for new places of landing for the future Martian missions: robotic or with people.

Keyword: space probe, rover, water, geology.

Martian missions – a long journey

The saga of the automatic Martian missions – a long journey having as a key word the word "victories" – began with the first images of the Martian surface taken by Mariner 4 in 1964, images that showed numerous craters resembling those from the Moon. This exploration was continued by Mariner 6 – July, 31st 1969 and Mariner 7 – August, 5th 1969. 76 images in the first case and 159 images in the latter were transmitted along with numerous data about the structure and the composition of the atmosphere. Mariner 9 was the first probe placed on the Martian orbit (November, 13th 1971) in order to make a complete mapping of the surface, thus becoming the first artificial satellite of Mars. It took 7329 sensational photos that made possible the preparation of the Viking missions. After the failure oh the Soviet Mars probes, the Americans continued the victorious march to Mars launching in 1976 the Viking missions, each of them being formed of two modules, an orbiter and a lander. Over 50000 photos were transmitted on Earth during the Viking mission (July, 20th 1976 – November, 12th 1982). Unfortunately, the biological experiments, though spectacular, were not conclusive: the Martian soil contains extremely oxidant components due to the effect of the solar ultraviolet radiations, whose presence make impossible the existence of any organic molecules.

The Mars Pathfinder mission (July, 4th 1997 – October, 7th 1997) had to be waited in order to restart the Martian exploration. The 710 kilos probe landed on Mars in the Ares Vallis region (Carl Segan station) and deposited on the ground a miniature vehicle, Sojourner, weighing about 10 kilos. The vehicle covered 100 metres. Over 16000 photos, more than 150 analyses of the rocks, data about the wind and the climate have been transmitted for 90 days.

One can say that NASA has begun the last planetary assault of the century since 1996, when it launched Mars Global Surveyor (MGS) (November, 7th 1996) that reached the destination on September, 12th 1997 with the help of the impressive Mars Pathfinder and the Mars Climate Orbiter probe (MCO). The probe was launched on December, 11th 1998 and burned in Mars's atmosphere.

Preceded by the one billion dollar - mission Mars Observer, launched on September, 25th 1992, that was an extraordinary failure because it lost contact just a few minutes before entering the Martian orbit, and with only a quarter of its budget, the MGS mission functioned between September, 11th 1997 and January 2003. Tens of thousands of photos were transmitted, photos that seem to certify not only the presence of the Martian rivers lots of billions of years ago, but also data about the objectives had in view, such as: the exploration of the magnetic field, the distribution of the materials under the crust, the mapping of the planet.

Another important part played by MGS was that of assisting the next fleet that was to take part in orbital or surface missions. The first missions were Mars Polar Lander (MPL) and Deep Space 2 (DS-2) launched on January, 3rd 1999.

MPL was supposed to end the 1990s in the most spectacular way. However, it failed lamentably although the calculations showed that not only

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should it have reached Mars's South Pole, but it also should have launched the two Deep Space 2 probes. The contact was lost at least until the day humans would step on Mars.

The Japanese launched on July, 4th 1998 the first probe (Nozomi) directed towards another planet (planet-B). Since it was not possible to place it on the Martian orbit in December 2003, the probe was placed on a solar orbit.

The inefficiency of the FCB concept – Faster, Cheaper, Better – was demonstrated by the failures of these Martian missions (it is known that the funds allocated for MCO, MPL and DS-2 were smaller than those allocated for Mars Pathfinder).

Since Mars is the 21st century number one target, the Americans decided, learning from mistakes and especially having as a starting point the past's undeniable successes, to elaborate a new plan referring to the exploration of the Red Planet. Thus, in the beginning of this century and millennium, NASA continued the glorious journey towards the conquest of Mars, launching the 2001 Mars Odyssey mission (April, 7th 2001).

Although Mars Odyssey did not land on the Martian surface, there were three instruments on board that analyzed not only the surface, but also the climate and the environment. These instruments were: THEMIS (*Thermal Imaging System*) – its main device being an infrared camera used for searching the carbonates, rocks that form only in the presence of liquid water; GRS (*Gamma Ray Spectrometre*) – had as objective the search at a few centimetres under the Martian crust, playing an important part in the identification of hydrogen; and MARIE (*Mars Radiation Environment Experiment*) - used to identify the level of radiations. The results were spectacular: at the poles, water (solid of course) represents 20 – 50% of the total mass of the stratum, the Martian ice, spread here and there on the surface of the planet, being found in large quantities only at the poles; in the areas placed near the Equator its proportion is under 1%, hydrogen being in strict connection with the elements from the rocks and not with the oxygen from the water. A first map of the planet was made having as a starting point the hydrogen.

Mars Odyssey opened a new era and prepared the next steps for the future Martian missions of 2003, becoming a radio-relay between the control centre and the Martian soil.

Since the measurements made by Mars Odyssey could not reach beyond one metre depth, the scientific researchers of the Red Planet had to wait for the Christmas of 2003 to come. That was when Mars Express station, launched by ESA (European Spatial Agency) on June, 2nd 2003 and Beagle 2 reached the proximities of Mars. While Mars Express had as main objective the detection of subterranean water, the automatic probe Beagle 2 should have done experiments in exobiology. From reasons unknown yet Beagle 2 could not communicate with Terra, nor with Mars Odyssey or Mars Express.

Equipped with ultramodern apparatus (panoramic cameras and radar), Mars Express has transmitted for 2 years photos and data about the crust and the microstructure of the planet. Thus, the apparatus on Aspera (*Energetic Neutral Atom Analyser*) searched for data to confirm if Mars had ever been "warmer" or "moister"; Omega had as main objective the analysis of the subsoil up to one kilometre (this was made using the radar) and the inventory of the elements that form the Martian soil; PFS spectrometre (*Planetary Fourier Spectrometre*) measured the variation of the carbon dioxide in each hemisphere and for the first time confirmed the presence of methane that could be a sign of a current volcanic activity or of biological processes. The first results transmitted by Mars Express in January 2004 were spectacular: large quantities of frozen water were discovered at the planet's South Pole.

January 2004 was the month Mars had other guests, this time sent by NASA. The guests were the 2003 Mars Exploration Rovers mission, two Mars Explorer probes launched on June, 10th 2003 and July, 7th 2003 that deposed two robot vehicles on the Martian surface at different dates and places. The names of the two probes were: Spirit (landed on January, 4th 2004 in the Gusev crater) and Opportunity (landed on January, 24th 2004 in the Meridiani Planum area). These automatons, a masterpiece of technology, weighing only 173 kilos and working with solar energy, had, each of them, an electronic brain, an antenna, 8 cameras, a mechanical arm and five instruments of analysis named Athena. They were capable of searching the shorter and the safer way to the objective, covering up to 10 kilometres a day! From the beginning of the mission up to now they called people's attention not only due to the images but also to the geological data transmitted, their scientific objectives being: collecting data to elucidate life's mystery on the Red Planet, characterizing the climate and the geology of the planet, preparing for the human exploration on Mars. The areas where the two robots had to study were wisely chosen, the experts supposing that there had been water in the past. This supposition was confirmed by NASA that announced at the beginning of April that the auto-propelled module Spirit had found certain traces of water in the area of Gusev crater after having examined a rock named Mazatzal. This statement was made public immediately after the discovery of traces of a "salty" sea in the Meridiani Planum area, discovery made just a week before by the other robot, Opportunity, after the examination of the sedimentary rocks. More important, the sea had had all the conditions to contribute to the development of life forms. Other news, as good as these, were expected from the two robots. As their first mission that ended on April, 5th, respectively April, 26th was an extraordinary success, NASA decided to prolong it till December.

For that moment, the presence of MGS probes (Mars Odyssey and Mars Express) placed on the Martian orbit and of the two robots placed on Mars was an unprecedented accomplishment in the annals of spatial exploration.

The exploration of the Red Planet will continue, the extraordinary success of the last mission being only the starting point of the new spatial era.

The mission Mars Reconnaissance Orbiter was planned for July 2005. It had as main objective the taking of very well-done pictures in all the wave lengths, especially in infrared, continuing to search for the so much wished for Martian water.

The first Martian mission that will last for a longer time, Mars Scout Program, will take place in 2007. Four missions have already been selected: MARVEL, ARES, PHOENIX and SCIM.

MARVEL (Mars Volcanic Emission and Life Scout) will study the atmosphere, will detect and locate if there is life and active volcanism. ARES (Aerial Regional Scale Environmental Survey) is a small robotized plane that will survey at a small altitude the Martian soil in order to precisely map it. SCIM (Sample Collection for Investigation of Mars) will bring samples on Terra. PHOENIX will be an evolved lander. All of them will study mainly the atmosphere.

In 2009, Mars Science Laboratory mission (USA) will carry a 500 kilos robot having a large radius of action and an estimated lifetime of 3 years. It will contain a smart lander equipped with a laser that will make possible the volatilization of rocks in order to study their composition. This mission will also test the capacity of controlling the precision of landing, as a precursory step not only for the future probes that will bring samples from Mars, but also for a possible vehicle run by man. 2009 will also be important for Net Lander mission (Europe) that will form 4 stations, each of having 30 kilos. They will work together and will study the Martian geophysics and meteorology.

The success of these missions will be crucial because the sanding on Mars, 2015 of the first robot-spatial mission (Mars Sample Return – MRS) will depend on them. MRS will bring samples of Martian soil on Earth. More variants are analyzed. One of them supposes the utilization of the orbital module as a return vehicle on Earth and another one will refer to the direct sending of the samples from Mars to Earth.

There are a lot of reasons to send humans on Mars. The scientific one refers to a better knowledge of the sister planet and to the search for an extraterrestrial life. Mars Direct missions, planned for 2020 – 2040, have this objective. Yet, a human mission on Mars will cost from 50 to 100 billions of dollars. Even assuming that the money will be raised, there still are lots of unsolved technological problems, such as the systems of propulsion, weightlessness and mainly the safety of the crew. With the nowadays technology it will take at least 12 months to reach Mars and come back. A journey to the Moon lasts only three days. That is why this could be the first feasible target of the American Spatial Agency and even the launching ramp towards Mars. The president of the USA has made some promises to the researchers. One of them refers to the resuming of human expeditions on the Moon that will serve as a launching ramp for more daring missions on Mars. Animated by the same Martian spirit, the European Spatial Agency (ESA) also has a long-termed program named Aurora destined to the robotic and human exploration of the Moon and of Mars.

Now the question is not ”Will humans reach Mars?”, but “When will they reach Mars?”.

References

1. DE LA COTARDIERE PH., PINOT., J.-P, 1998 - *Larousse – Dicționarul Spațiului*. Editura Univers Enciclopedic, Bucureşti.
2. *** *L'Astronomie* – Bulletin de la Société Astronomique de France, Vol. 117 – mars 2003.
3. *** *L'Astronomie* – Bulletin de la Société Astronomique de France, Vol. 118 – mars 2004.

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HUBBLE SPATIAL TELESCOPE' S RECENT DISCOVERIES

DORICA ŢÎRDEA[*]

ABSTRACT

ŢÎRDEA D., 2006 - Hubble spatial telescope's recent discoveries. *Studii şi Comunicări*, Compl. Muz. Şt. Nat. „Ion Borcea” Bacău, vol. 21: 581-582.

The Hubble Spatial Telescope (HST), as space observer, was an important project which had a double impact on both the scientific world and the general public and it is considered NASA and ESA's second biggest success after APOLLO.

It greatly contributed to the spatial sciences and exploration due to its numerous discoveries – essential novelties in astrophysics, spatial astronomy and cosmology – discoveries that opened new perspectives on the Universe.

Key words: Hubble Space Telescope (HST), space observer, important project, numerous discoveries, essential novelties, astophysics, spatial astronomy, cosmology, Universe.

On April, 25th 1990 the Discovery spaceship placed Hubble Spatial Telescope, one of the biggest and the most complex telescopes made until now on a circumterrestrial orbit, at a height of 600 km. Many of the HST's discoveries opened new perspectives and revolutionized the astronomers' way of thinking. The most important scientific justification for the building of HST was the determination of the size and age of the Universe by detecting the variable cepheids (HST is able to detect the most luminous of them in galaxies situated at 30 mega parsecs) – these permit the measuring of the distances up to the scale of the Local Super Cluster, an agglomeration of numerous groups of galaxies that include the Local Cluster and the Virgin Cluster. HST made possible a progress in the measuring of the scales of the extra-galactic distances due to the cepheids' period-luminosity relationship.

With the instruments found on HST observations of some galaxies placed at very big distances were made. These galaxies evolved in very different ways. Thus, there have been discoveries of galaxies that evolved elliptically, formed at a very short period after the Big-Bang and that did not evolved very much; spiral galaxies, like ours, that needed a longer time to form and suffered dramatic changes; and dwarfish galaxies that appeared very quickly and disappeared even quicklier and without trace (for example the Abell 2218 Cluster of galaxies functions as a powerful lens for the observation of these faraway galaxies: small structures formed of gases and young stars that can stand for the blocks that helped forming the present galaxies). By determining exactly the distances of the galaxies the astronomers can calculate the Universe's age. After the latest discoveries, it was found that the Universe is 13.7 billion years old, much younger than it was thought.

HST looked thoroughly beyond space and time in order to study the “Dark Ages” galaxies. The most beautiful views of HST are Hubble Deep Field (HUDF), a spot on the sky that revealed a region with ~10000 galaxies formed between 400 and 800 million years after the Big-Bang.

The detecting of HST of what seems to be the primordial helium that gave birth to the galaxies during the early universe and of other light elements like lithium that exist in space in quantities corresponding to those predicted by the theory of Big-Bang, represented another confirmation for the validity of this theory. HST found traces of some part of the primordial helium in Cosmos – the first atoms that formed right after the birth of the Universe. According to the Big-Bang these light atoms (they contain only a proton and an electron) represent the “classic” matter that was found in the Universe.

The research team did not directly detect the primitive clouds of hydrogen that are dissipated nowadays, but the oxygen that was first heated and then ionized by the primitive hydrogen. To do so the researchers used a natural probe: the light coming from a faraway quasar, the nucleus of a very bright galaxy. Once analyzed, its spectrum was found to contain the traces of the ionized oxygen that was between the quasar and HST. This confirmed once

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again that the predictions of the Big-Bang perfectly corresponded to the reality.

The Dark Matter's nature is one of the fundamental enigmas of nowadays astrophysics. The examination not only of the clusters of galaxies, but also of the individual galaxies proved that no more than a quarter of the quantity of matter in the Universe consists of normal atoms and of molecules that form the familiar world around us. No more than a quarter of this normal matter emits the radiation that we see from the stars and the hot gas. Thus, a big quantity of the matter in the Universe is dark and of an unknown composition (it was Fritz Zwicky that discovered the existence of the Dark Matter in 1937). During the last ten years the research projects brought forward possible candidates that could form the Dark Matter: not only hard subatomic WIMPs particles, but also massive compact MACHOs objects – dead or dying stars: neutron stars or cold dwarfish stars, black holes of different sizes or collections of planets of different sizes formed of rocks and ice. Combining the curved light of the micro lens from the MACHO project and the images of high resolution from HST the first direct detection of the objects was established: their mass, distance and speed. The results indicated the fact that a great quantity of the normal Dark Matter from and surrounding our galaxy exists in the MACHO form and is not as dark as it was thought! The future researches of the MACHO objects will have the potential to map this form of the Dark Matter and to find its role in forming the galaxies.

HST found the Dark Matter in a cluster of galaxies – CL 0024+1654 (it thoroughly examined 39 regions of the cluster) – and studied the way in which it is distributed and which is its recent development. The study showed that the density of the dark matter is suddenly more reduced if it is farther of the cluster's centre.

HST observed the evolution of the Ia supernovas so that the astrophysicists could obtain curves of luminosity and variations of the spectrum in UV radiation precise enough to make possible a better correlation between the quantity in hard metals (metallicy) and distance. As the Ia supernovas are used in present as terminals for estimating the distance up to different galaxies, the data gathered by HST will be used as standards for this method based on the study of metallicy.

HST discovered undeniable evidences of some super massive black holes. By measuring the tornado-like movement of the stars and gas in the galaxy's centre the astronomers calculated the quantity of matter found there. For three galaxies, the mass of million or billion of suns (stars having the mass equal to that of the Sun) is concentrated in an area of the space having the dimension of our Solar System. Thus they came to the conclusion that there exist very massive compact objects that can be only black holes.

HST confirmed the existence of some special classes of objects very hard to seize and searched for a long time named brown dwarf. These objects are too big to be planets and too small to be stars. The astronomers predicted the existence of these objects without being able to see them from Earth, but HST captured images that separated the brown dwarf from the star around which it was rotating.

HST discovered a curious web in the dust disk that surrounds Beta Pictoris star (the astronomers suspected it to have a planetary system).

HST made possible the illustration, the direct exemplification through pictures of the asteroids and of trans-Neptunian objects (size, the search of the companions) and the photometry of the comets' nucleus. HST (ACS) discovered on May, 15th 2005 two candidates – satellites of Pluto: S/2005 P1 and S/2005 P2 (they were given these names after the confirmation of the International Astronomic Union) placed at ~44000 km from the planet and 5000 times more obscure than the planet. If this is confirmed, Pluto will become the first object from Kuiper Belt that has more than a satellite. This suggests that other objects from Kuiper Belt could have multiple satellites.

The clear resolution of HST permitted the monitoring of the planets and of the satellites from the Solar System.

HST recently studied the Moon, especially the areas abundant in titanium and iron oxides. The extraordinary interest in oxygen and metals dues to a project meant to realize a future lunar base.

HST studied the atmosphere of the exoplanet Osiris (HD 209458b) from the Pegas constellation, 150 a.l. distance from Earth, magnitude 7 (visible with the telescope). Data on the planet: D=1.3 times D of Jupiter; mass=0.7 times the mass of Jupiter (220 times the mass of Earth); orbit=1/8 from the Mercury orbit around the Sun (7 million km); an extra-solar planet like Jupiter; a giant gaseous planet; it eclipses 1.5% of its star's circumference; transit: three hours every 3.5 days; surface temperature=~1000^0 C; complex atmosphere: sodium in the down atmosphere, evaporated hydrogen in the upper atmosphere (the evaporated quantity=10000tones/s – thus, the planet loses 0.1% from its mass in 5 billion years) forming a tail of approximately 200000km, and oxygen and carbon (these elements vaporize in the upper atmosphere under the scorching heat of the star. This phenomenon explains the "desert" of planets existing at less than 7 million km from their star - the planets disappear leaving behind only their central nucleus - a new class of extra-solar planets: chthonian planets.). The observation of the structure and the chemical structure of the planet was made in UV light with HST's STIS spectrograph.

HST tried to answer the big questions that humanity asked itself from remote times, questions about man's place in the Universe, its understanding, its origin, its future and the presence of other forms of living.

References

1. www.hubble space telescope

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PYRAMIDS OF THE WORLD

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ABSTRACT

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In this paper are presentet many pyramids, from all over the world: from Europe, to North America, to Japan, to South America, to Africa. Pyramids were found everywhere and, in many cases, they represent religious and astronomical places, made for prayers and sacrifices (human or animals).

Key words: pyramids, world, astronomical, solstice, equinox, peoples.

Pyramids in Australia - The town of Gympie, at Tin Can Bay, north of Brisbane, Queensland, is the unlikely site of a pyramid complex. The first Europeans to come into the area in the 1830's learned of them from the now extinct Kabi speaking people of Gympie, known then as the Dhamuri. According to the Aboriginals, brown skinned, blue eyed, blond haired beings with Dolphin pendants came from the star Orion and built the pyramids and temple sites, but water came in and destroyed it all long ago. The ruins were taboo to them. Settlers took the stones of the pyramids and other buildings and used them as foundation stones for the main street of Gympie and the construction of buildings, including the local church, which still stands. There were stone statues like the Easter Island statues and also animal statues. These have since been destroyed or are hidden, but photos and sketches of them remain from the first white man to come into the area. Even the tunnels under Gympie were dynamited. All but one of the Pyramids was bulldozed into the ocean by the army in the 1950's and the lone survivor remains on private land with a strict "no trespassing policy. The Pyramid is 100 foot high and designed with a series of terraces up to 4 feet tall and eight feet wide. The army sealed the entrance in the 1930's after investigating reports of cattle wandering into the pyramid, when an opening was still accessible, and never coming out. No reports or findings are available. In recent years, according to locals, the owner has attempted to destroy the pyramid in the hopes of discouraging visitors to the site. Artifacts have survived including the 'Gympie Ape', which was dug up in 1966 and is thought to be a statue of the Egyptian God Thoth, who was often portrayed as an ape, and another resembling Ganesha from Indian mythology. Egyptian God "Thoth" is clutching the Tau or the Cross of Life. This statuette is badly weathered with age. Thoth was the god of writing and wisdom, depicted as an ape by the Egyptians until about 1000 BC when he became an Ibis-headed human bodied deity who recorded the judgment of the souls of Amenti, the after world. Thoth's symbol was the papyrus flower.

Pyramids in Belize - Altun-Ha means "stone water" - is located approximately 30 miles north of Belize City. This ceremonial center, located six miles from the sea, was important as a trading center and as a link between the coast and the settlements of the interior. Within the central portion of the site there are more than 500 structures. The entire city covered some 1.8 square miles and contains around 250 to 300 unexcavated mounds. Population estimates for Altun Ha at its peak are 9,000 to 12,000. Also, a treasure of over 300 jade objects was found there, including the ornately carved head of Kinisch Ahau, the Mayan Sun God. This head, weighing 9 3/4 pounds and measuring nearly 6 inches from the base of the crown, is believed to be the largest Maya jade carving in existence. Caracol means "conch shell" or "snail", is located south of San Ignacio, in the Cayo district. Though only considered to be a simple Mayan ceremonial center when discovered in 1938, it was later found to be one of thelargest sites in all the Maya World. The center of the site has about 20 major plazas and the pyramid, the Canaa, meaning "sky palace", which

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rises 140 ft and is the tallest man-made structure in Belize. Cerros is located in the north of Belize, on a peninsula, in the Bay of Chetuma. Its tallest structure rises 65feet above the plaza floor and the site includes three large acropolises which dominate several plazas bordered by pyramids. With it's location at the mouth of the New River, Cerros was important as a coastal trading center.

Cuello is located on private property southwest of Orange Walk Town and most of it is still overgrown. Cuello is one of the oldest of all Maya sites, dating from 2600 BC.

The El Pilar Archaeological Reserve is located just out of the western town of San Ignacio, astride theBelize-Guatemala border. El Pilar has more than twenty-five identified plazas. In an area of 100 acres, there are morethan a dozen large pyramids and many other buildings. It is the largest center in the Belize River area.

Las Milpas is located in the Rio Bravo Conservation Area in northwestern Belize. The site contains more than 24 courtyards and over 85 structures and is the third largest Maya site in Belize. The Great Plaza at Las Milpas is one of the largest in the Maya world. Beyond the Great Plaza lie other plazas, pyramids, and buildings. There is evidence of advanced agricultural techniques with terracing and water management systems.

Lubaantunis located northwest of Punta Gorda near the village of San Pedro, Columbia, Lubaantun is noted for its unusual style of construction. The large pyramids and terraces are made of precision cut stone blocks fitted together without mortar.

Pyramids in Ecuador - The complex of pyramids and funeral mounds found at Cochasqui is a tangible testimony of a past culture and of pre-Hispanic architecture. Cochasqui is made up of 15 truncate pyramids and about 20 dispersed funeral knolls, all of which are enclosed in a 83,9 hectares area. The pyramids of Cochasqui are considered the most important archaeological site in the Northern Andes of Ecuador. In 1979, the pyramids of Cochasqui were declared a Cultural Patrimony of Mankind. The Provincial Council of Pichincha was given the task of maintaining the integrity of the archaeological park and furthering scientific research, conservation and restoration. The history of Cochasqui goes back from year 950 AD to the year 1550 AD, with two well differentiated periods defined by the type of pottery found by archealogists. The first period, Cochasqui is characterized by the vasija zapatiforme (shoe shape pot), while, in Cochasqui I, the typical ceramic figures discovered were vasija tripode and the g ora de fondo puntiagudo (amphora).

Several hypotheses have been formulated in order to explain the nature and purpose of the monumental complex comprising Cochasqui:

- It was a ceremonial-ritual center

- It was a home compound center for native elites (caciques)

- It was an astronomical center of observation.

Presently, the Cochasqui complex has an open air ethnographic museum which displays various tenants of the Cochasquies' way of life. In addition to the ethnographic display, there is a llama reproduction reserve, a botanical garden specialized in Andean plants with medicinal purposes and a small but informative archaeological museum. The pyramids of Cochasqui are most frequently visited during the solar soltices and equinoxes, when local people gather to celebrate the passage of the sun. The solar seasons also indicate the time of sowing and harvesting for the locals. Potatoes, corn, beans and quinua are the essential nutrients for the inhabitants of this part of the world. Although they may not be as impressive as many of the Inca ruins to be found in Ecuador, the importance of the Cochasqui Pyramid Complex is indisputable. Believed to have been built by Cara Indians between 950 AD and 1550 AD, the 15 clay pyramids are situated on the equator and were the location of various sun-orientated celebrations.

Pyramids in El Salvador - Part of the large Chalchuapa site, Tazumal comprises a group of flat-topped stepped pyramids and is still being studied by historians. Located 78km from San Salvador on the outskirts of the city of Chalchuapa. El Salvador is the smallest and most densely populated Central American country, and the the only one without a coast on the Caribbean. As part of the Mayan world, El Salvador has its share of impressive pre-Columbian sites.

San Andres: Another group of stepped pyramids positioned between two rivers 36 km from San Salvador in the Zapotitan Valley.

Guija:Close to the Guatemala border on the Guija Lake. Many archaeological treasures can still be found, untouched, on the lakeshore.

Cihuatan: Ruins of cities cover an area of 4 square kilometers. A stone wall is still standing that was originally one of the ball courts called Tlatchli.

Joya de Ceren: A pre-Columbian settlement that was buried under 5 meters of ashes from the eruption of Laguna Caldera Volcano in 600 AD. The site was discovered in 1978. Located 36 kms from San Salvador.

Corinto: Consists of two caves situated on a broad plain 1 km north of the village of Corinto. Prehistoric drawings about 10,000 years old can be seen on the cave walls.

Pyramids in Germany - Cairn of Barnenez - The pyramids of Germany are known as "cairns" and are the largest megalithic structures on the European continent. Their construction is the 'stone-stepped' design. They can be found throughout the country and the continent.

Pyramids in Ireland - Near Drogheda, 45 kilometres north of Dublin on the east coast of Ireland, exists a concentration of standing stones, earthworks and passage graves.One of these, Newgrange, is the largest pre-historic structure in Ireland and one of the oldest in the world. It dates back to 3250 BC. It appears that we have drifted a long way from what might be defined as a pyramid. This egg-shaped mound of pebbles was once 14 metres in height with a diameter of 76 metres hardly a massive monument compared to the largest pyramids, but still more than a days work. Like Silbury Hill it has no straight sides, and appears not to point to any cardinal directions, astronomical events or other structures. But if you venture inside, on the right day of the year, something magical happens. Like the Egyptian pyramids, Newgrange contains a passage and chambers. These were constructed using giant slabs of stone, and then buried under a mound of pebbles. At the end of an 18 metre long, one metre wide passage are three chambers. The roof above them, although not required to withstand as much weight, uses the same corbelled design as the pyramids in Egypt. At dawn on the midwinter solstice, the suns rays shine through a special window above the passage entrance, down the passage and illuminated the centre of the chambers. Precisely and deliberately.

Pyramids in Italy - They are the first pyramids ever discovered in Italy and the dimensions are quite impressive; the highest pyramid is 150 meters tall. They are stone buildings, as recent excavations have proved. However, they are now completely covered by ground and vegetation, so that they now look like hills. The inclination degree of all the three pyramids is 42/43 and there is a perfect alignment with the Orion constellation. There are a lot of similarities to the Egyptian pyramids.

Their age is still undefined although they are surely older than 3000 years. Nothing was found nearby which may help to date the structures and in the area there was not any civilization able to build similar structures at the time. The people who lived there were mainly gatherers and hunters.

Pyramids in Japan - In Japan one can find an ancient stone pyramid. It is a beautifully shaped monolith, about six and a half feet tall and twelve feet at the base, practically lost in the thick forest growth on the slope of a hill near the town of Ena, in central Honsu, largest of the Japanese islands. Cut from a single, massive block of gray granite, the object was a pyramidian, a smaller version of the Great Pyramid and its full-size cousins. This trignon, as they call it, might have passed for the missing capstone of its gigantic counterpart in Giza. People leave flowers at the base of the pyramid. Their veneration is more in keeping with Shinto practices, which predate Buddhism in Japan by unknown centuries. There are few folklores about the pyramid. The only mythic element still current concerns a white serpent that dwells either within or underneath the trignon. It is a beneficent creature, which local people worship by laying out plates of small eggs for the snake to consume. Somehow, this practice is related to human and agricultural fertility. But who cut the straight angles of the Japanese pyramid, when and for what purposes are utterly unknown. Nor is it the only such example. Perhaps 100 meters further up the same hill another trignon of approximately the same dimensions stands in an apparent alignment whose suspected celestial orientation has not yet been determined. At least one more pyramidian lies toward the north. Together, the monolithic trio forms a triangular relationship, the significance of which continues to escape investigators.

Pyramids in Java, Indonesia - Not a lot is known about this site, except that it has the only pyramidal temple in Southeast Asia, and dates to 1416 - 1459 AD.? It bears an uncanny resemblance to the Central American pyramids. There is also a twin-headed serpent. The serpent god was Quetzalcoatl.

Pyramids in Mexico - Deep within the jungles of Mexico and Guatemala and extending into the limestone shelf of the Yucatan peninsula lie the mysterious temples and pyramids of the Maya. While Europe was still in the midst of the Dark Ages, these amazing people had mapped the heavens, evolved the only true writing system native to the Americas and were masters of mathematics. They invented the calendars we use today. Without metal tools, beasts of burden or even the wheel they were able to construct vast cities across a huge jungle landscape with an amazing degree of architectural perfection and variety. Their legacy in stone, which has survived in a spectacular fashion at places such as Palenque, Tikal, Tulum, Chichen Itza, Copan and Uxmal, lives on as do the seven million descendants of the classic Maya civilization. The Maya are probably the best-known of the classical civilizations of Mesoamerica. Originating in the Yucatan around 2600 B.C., they rose to prominence around A.D. 250 in present-day southern Mexico, Guatemala, northern Belize and western Honduras. Building on the inherited inventions and ideas of earlier civilizations such as the Olmec, the Maya developed astronomy, calendrical systems and hieroglyphic writing. The Maya were noted as well for elaborate and highly decorated ceremonial architecture, including temple-pyramids, palaces and observatories, all built without metal tools. They were also skilled farmers, clearing large sections of tropical rain forest and, where groundwater was scarce, building sizable underground reservoirs for the storage of rainwater. The Maya were equally skilled as weavers and potters, and cleared routes through jungles and swamps to foster extensive trade networks with distant peoples. The pyramids of Teotihuacan rise as high as twenty-story buildings, above the central Mexican highlands with a grandeur and mystery that stirs the imagination and inspires the soul.All of the buildings are aligned with the stars and the solar system from precise survey points in the nearby mountain range, using an advanced understanding of mathematics, geometry and astronomy.

Little is known by traditional researchers about the pyramids of Teotihuacan (pronounced tay-oh-tee-wah-con, and simply referred to as "Teo" by the locals). Built by the Toltecs, Teo was once a city the size of ancient Athens and Rome. It thrived as the primary center of learning and culture in America for over one thousand years, before it was abandoned about fifteen-hundred years ago. According to legend, after the fall of Teotihuacan, two major paths of sacred knowledge formed. One Toltec path went to Tula near present day Hidalgo. The magic of Tula can be compared to what our culture might term "black magic." The generally more enlightened path called the Path of Freedom went south toward Xochicalco, near present day Cuernavaca, and also eventually went into hiding. The term "Toltec" as used by the Aztecs (who came many years after the Toltecs) meant either a "great wise one" or a native healer or artist who followed a certain tradition; it was not necessarily meant to define a specific ethnic group. In fact there is evidence that Toltec society was a relatively harmonious blend of several of America's early native cultures. The Olmecs and the builders of Monte Alban in Oaxaca, with whom the Toltecs traded, revered the Toltecs and regarded them as the most highly advanced society in religion, magic and art. Yet, unlike the art of other early American societies, Toltec art depicts only two gods: the earth goddess and the rain/sky god. The fact that Toltec art does not prominently portray many gods for worship, supports the belief, common throughout America for over one thousand years, that the Toltecs were able to communicate directly with the gods in the sun, the moon and the stars. Cholula was the Holy Place of the three major satellite cities of Teotihuacan. It was destroyed by Cortes and his men on their way to take Tenochtitlan. The pyramid is in the present day city of Cholula and in volume (before destruction) was larger than the Egyptian pyramid of Cheops. After conquest a church was built on top of the ruins.

The pyramids of Teotihuacan - The plazas, avenues, and great pyramids of the city of Teotihuacan were laid out as a symbolic sacred landscape of artificial foothills and mountains. The complex of approximately 600 pyramids of various sizes is dominated by the great Pyramid of the Sun which, it was discovered in 1971, was built over a natural cave with four chambers (cf. Sacred Caves). Mesoamerican belief saw caves as gateways to the spiritual world (called Xibalba by the Maya). The cave contained remains of offerings and may have been a focus for shamanistic rituals from a much earlier period. There can be no doubt that the Pyramid of the Sun was deliberately built over the sacred cave. Teotihuacan was probably Mexico's biggest ancient city, with perhaps 200,000 residents at its peak in the 6th century, it was virtually abandoned by the 7th century.

Pyramids in Peru - Ancient pyramids in Peru had the same functions as Pyramids found in other ancient civilizations around the world. Most were used as places to worship their Gods and Goddesses - rituals (at various equinoxes and solstices) - ceremonial rites of various kinds. Often they were built on a place where the Earth energies were high - specific grid points following the measurements of Sacred Geometry. Rumors of a vast hoard of gold prompted the famous Norwegian scientist and explorer Thor Heyerdahl to investigate the area around Tucume in northern Peru. The result was an incredible new archaeological discovery of 26 pyramids. In this documentary, Dr. Heyerdahl works with his usual enthusiasm and thoroughness to chart and excavate the area involved, assisted by international experts and hundreds of local workers and young students who are also taking part in the excavation work. Forty tombs pre-dating the arrival of the Spaniards were opened, and enough Inca and Chimu artifacts unearthed to justify the building of a museum at Tucume. Heyerdahl has already drawn some interesting conclusions from these finds, many of which help to maintain how various parts of this vast continent were able to establish and maintain contact with one another, as well as how seafarers in prehistoric times forged links between different civilizations. Four burial chambers in the 600 meter long Huaca Larga pyramid were excavated. Inside the burial chambers the bodies of 16 female weavers sacrificed to the gods were found.

The area near Tucume consists of 26 massive pyramids which suggest a civilization that flourished in the now endless desert for perhaps more than 1,500 years. It is the most extensive archaeological work ever undertaken by Heyerdahl. He and his team have barely scratched the surface and the project will require many years of excavation work before it is completed. It is not surprising that archaeologists from around the world are watching with keen interest Heyerdahl's excavation project at Tucume, and some consider this to be the most interesting excavation site on the American continent.

Ichimay Culture; had a Magic-Religious function of adobe brick. Theories about the Pyramids in Peru place their creation at the same time the Nazca Lines were created. The pyramids had flat tops looking much like those in Mexico.

Pyramids in Spain - Canary Islands - Six step pyramids were discovered in 1998 near Guimar, a town on the eastern shore of Tenerife Island, about 40 kilometers (24 miles) south of Santa Cruz de Tenerife - the Canary Islands. They are rubble-filled with facings of black volcanic stone and are the result of multiple episodes of construction. There are six step pyramids, reaching a maximum height of about 12 metres. The main complex of three pyramids were found to be astronomically orientated with the sunset of the summer solstice. Stairways ascend from a level plaza to the top of each pyramid, where there is a flat summit platform covered with gravel. The stairways are all on the west wall, suggesting a ceremonial purpose, because someone ascending them on the morning of the solstice would be directly facing the rising sun. The six pyramids in Tenerife are quite small, like training exercises for those in Central America. Long dismissed by locals as mere piles of rubble, Norwegian explorer Thor Heyerdahl turned up and declared that they were indeed pyramids, not unlike those in Tucume, Peru that he had been studying.The Canary Islands are a popular solution to the location of Atlantis, based on their location west of the Mediterranean, and their mountainous terrain they are part of a volcanic archipelago with marine trenches as deep as 3,000 metres and mountains as high as 3,718 meters above sea level. Archaeological findings suggest that the original inhabitants were Berbers who arrived from north Africa around 200 B.C. However, some early navigators reported the Canarians as being a race of tall, blond-haired, blue-eyed people, perhaps suggesting northern European or Atlantean origins.

Pyramids in Tahiti - When Captain Cook visited Tahiti, he described the Marae of Mahaiatea as having a stepped pyramid with a base of 259 by 85 feet. Unfortunately all that remains today is a pile of stones.

Pyramids in the North America - The largest pyramid mound in the USA, the Cahokia Mound can be found about twelve miles from Saint Louis, near the Mississippi river. Covering sixteen acres, the sacred mound was originally over 35 feet high and more than four city blocks long. At the top, a priest lived in a wooden shrine, dedicated to the sun god. It is 30 metres high and dates back to 1100-1400 AD. "The largest of these mounds, Monk's Mound covers 16 acres; it rests on a base 1,037 feet long and 790 feet wide, with a total volume of approximately 21,690,000 cubic feet, a base and total volume greater than that of the pyramid of Khufu, the largest in Egypt. In all the world, only the pyramids at Cholula and Teotihuacan in central Mexico surpass the Cahokia pyramid in size and total volume. No other structure in the United States approached the size of the Cahokia pyramid until the building of airplane hangars, the Pentagon, and skyscrapers in the twentieth century."

There are more than one hundred other, smaller mounds at Cahokia as well as Woodhenge, which is of course a wooden counterpart to England" s Stonehenge. According to the Cahokia website, in March 1998 something unexpected happened: "During the process of installing horizontal drains to relieve the internal water in Monks Mound that had contributed to several severe slumping episodes along the west side (Second Terrace), the drilling rig encountered stones about 140 feet in and 40 feet below the surface of the Second Terrace. The operator said it felt like "soft stone," probably limestone or sandstone, and that it was mostly cobbles or slabs at least six inches in diameter. The drill went through about 32 feet of stones and the drill bit broke off. We have no idea what it is, what shape or size it is, or why it is there. It should not be there. No other cores or excavations have revealed stone in Monks Mound or any other mound at the site, or, as far as we know, at other Mississippian mound sites.We do not know its vertical thickness or the extent of it horizontally, other than the 32 feet that the drill went through."

Poverty Point, Louisiana, USA- Poverty Point combines mounds with an aspect of ancient Rome an amphitheatre. Consisting of concentric ridges 5-10 feet high and 150 wide, the construction has a diameter of 3/4 of a mile, five times the diameter of the Colosseum in Rome. The ridges were built with 530,000 cubic yards of earth (over 35 times the cubic amount of the Great Pyramid of Giza). Of the earth mounds, one has a base of 700 feet by 800 feet and is 70 feet high. It is shaped like a bird.

Pyramids in the Sudan - On the way from Khartoum to Port Sudan, about 200 km north-east of Khartoum, near Bagrawiya, lies ancient Meroe, the home of a few dozens pyramids spread over a small hill about one quarter square kilometer in size. The pyramids, much smaller than their well-known counterparts in Egypt, are the remains of a royal cemetery from the Meroitic kingdom (between 300 B.C. and 300 A.D.). The region of the Nile Valley which lies in the northern part of the present Sudan, has been influenced by the Egyptian civilization since the time of the Ancient Egyptian Kingdom. This influence grew stronger during the occupation by Egypt in the period of the Middle Kingdom and reached its summit after the Egyptians conquered the whole region up to the 4th Nile Cataract. The Egyptian colonization lasted for almost five centuries and came to an end when in the twelfth century B.C. the Egyptian Empire fell into pieces. Four hundred years later it were the kings of Napata in northern Sudan who ruled the Nile Valley from the Blue Nile down to the Delta. They revived the burial customs of the pyramid many centuries after the Pharaos had stopped building them and employed Egyptian artists in their architectural works. While the Napatan kingdom had to give up Egypt in 661 B.C. and subsequently the Egyptian influence started to decline, the burial traditions still survived and, after the the transfer of the kingship to the Meroitic line in the third century B.C., were taken over by the kings of Meroe - The Kushite Kingdom. As with many of the pyramids around the world, changing ecological conditions - weathering, winds and dust storms over the millennia have caused great damage to the one beautiful monuments.

Egipt - The Pyramids of Giza - The age of the first ancient wonders of the world began with the pyramids of Sneferu, he built three pyramids and may have had a hand in others. His pyramid at Medum began as a step pyramid and was then modified to form the first true pyramid. He built two pyramids at Dahshur one called the Bent Pyramid because its upper part has a shallower angle of inclination than the lower part.Seneferu's Bent pyramid at Dahshur was originally planned as a true pyramid, but its geometry was altered at a point just above half it's height. The angle of incline was decreased from 54º 31' 13" to 43º 21'. When Khufu, also known as Cheops, became pharaoh one of his first acts was to curtail the growing power of the priesthood. He "shut up all the temples and forbade sacrifices". As a priest's living came from performing these rituals it is not surprising that Khufu was unpopular with the religious orders. Khufu's pyramid at Giza showing the plan of passages and burial chamber. At 146.5 m (481 ft) high, the Great Pyramid stood as the tallest structure in the world for more than 4,000 years. Today it stands at 137 m (449.5 ft) high, having lost 9.5 m (31 ft) from the top. Some believe that his pyramid at Giza was built by slaves but this is not true. One hundred thousand people worked on it for three months of each year. This was the time of the Nile's annual flood which made it impossible to farm the land and most of the population was unemployed. He provided good food and clothing for his workers and was kindly remembered in folk tales for many centuries. There are three pyramids at Giza, each of which once had an adjoining mortuary temple. Attached to this temple would have been a covered causeway descending down to a valley temple, near the Nile. The 'great' pyramid itself is truly an astonishing work of engineering skill - for over four thousands years, until the modern era, it was the tallest building in the world. The sides are oriented to the four cardinal points of the compass and the length of each side at the base is 755 feet (230.4 m). They rise at an angle of 51 52' to a height , originally, of 481 feet (147 m) but nowadays 451 feet (138 m). It was constructed using around 2,300,000 limestone blocks, weighing, on average, 2.5 tons each. Although some weigh as much as 16 tons. Until recently, relatively speaking, it was cased in smooth limestone but this was plundered to build Cairo. Is it conceivable that by bringing together so many people and giving them a common goal, that of making a mountain, a national identity is forged in their hearts. From Upper and Lower Egypt communities would have got to know each other and a common bond would have been manifest in the object of the pyramid. If this is true it is unique because all other forms of nationalism have grown out of war. For example England and France in the Hundred years war and the USA through the revolutionary, civil and Indian wars. Khafre's Pyramid is second to his father Khufu's Pyramid in size, but since it is built on higher ground and at a steeper angle (about 53°), it appears taller. It is 695 feet on a side at the base and stands 450 feet high (originally 473 feet). Scholars estimate its overall volume at a mind-boggling 58,100,000 cubic feet. Menkaure, also known as Mycerinus, ruled from 2490 - 2472 B.C. He was king of the smallest of the three pyramids at Giza, and is believed to be Khufu's grandson. In Egyptian legend, the Sphinx (the statue that guards the Pyramids) appeared to a young prince in a dream. It promised to make him king if he cleared away the sand covering its body. He did so, and became Thutmose IV.

Chephren, the same king who built the second pyramid at Giza, also built the Sphinx at Giza. While building his pyramids, a laborer noticed that the limestone lump near by looked like a lion. Unless they could find another use for it, it would have to be leveled since it was so close to the pyramid. Since the king was often represented by a lion, they decided to make a statue with the head of king Chephren and the body of a lion. The body is 66 feet high and 240 feet long. The nose was the height of an average Egyptian and the lips stretched seven feet across. Almost as soon as it was built, the king it resembled was forgotten and the Sphinx became a god by itself. Presents and prayers were brought to a temple built near by. It was popularly thought to have been created by the gods.

Other sphinxes were also made. At Abu Roash, a female sphinx associated with Chephren's older half brother has been discovered. Probably representing a Fourth Dynasty queen, it might be older than the one in Giza. Later variations on the sphinx included leaving the lion's ears and mane and only humanizing the face, and the criosphinx, with the head of a ram.

Rezumat

Lucrarea prezintă piramidele din lumea întreagă: piramidele din Europa, America de Nord, America de Sud, Africa, Japonia. De-a lungul timpului, s-au descoperit piramide mult mai vechi decât cele din Egipt, dar, în general, aproape toate aveau aceleaşi scopuri: erau folosite drept calendare astronomice (se făceau diferite ritualuri la echinocţii şi solstiţii), erau edificii ridicate în cinstea unor zei şi, la unele, se aduceau chiar jertfe (umane sau animale).

References

1. www.corelight.org
2. www.crystalinks.com
3. www.pbs.org